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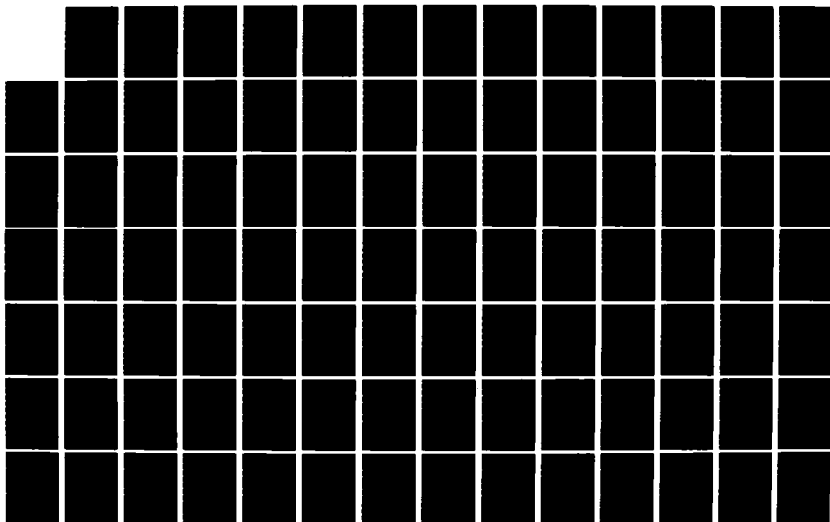
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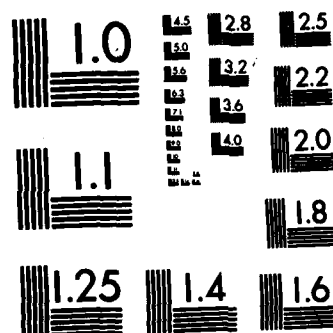
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AMMRC TR 81-38

SCATTERING MEASUREMENTS OF RAYTRAN ZINC  
SELENIDE IN TRANSMISSION AT WAVELENGTHS  
OF 0.6328, 3.39, AND 10.6 MICROMETERS

August 1981

F. O. BARTELL, A. G. DeBELL, E. L. DERENIAK,  
J. HUBBS, T. STUHLINGER, and W. L. WOLFE  
Optical Sciences Center  
University of Arizona  
Tucson, Arizona 85721

FINAL REPORT

Contract No. DAAG46-79-M-0871

Approved for public release; distribution unlimited.

Prepared for

ARMY MATERIALS AND MECHANICS RESEARCH CENTER  
Watertown, Massachusetts 02172

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The transmission scattering of three samples of different thicknesses of zinc selenide were measured. The samples were 1/4", 3/4", and 1" thick. Fifty-four plots of the BTDF were made utilizing the scattering data obtained at 0.6328, 3.391, and 10.6 $\mu$ m.  - 1/4 in, 3/4 in, and 1 in		

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## FOREWORD

This report was prepared by Optical Sciences Center, University of Arizona, for the U. S. Army Materials and Mechanics Research Center under Contract DAAG46-79-M-0871, and covers work for the period from August 1979 to April 1981. J. A. Hofmann at AMMRC was the program technical monitor and W. L. Wolfe at the Optical Sciences Center was the principal investigator.

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## SCATTERING MEASUREMENTS

### Introduction

This document reports the scatter measurements made on vapor deposited "Raytran" zinc selenide material (manufactured by Raytheon) and a mirror surface at three wavelengths, 0.6328  $\mu\text{m}$ , 3.39  $\mu\text{m}$ , and 10.6  $\mu\text{m}$ . The scattered radiation from the transmitted beam for a transparent window, such as zinc selenide, is the sum of contributions from three sources; which are the two polished surfaces and the scattering due to the bulk material. The bulk scattering results from bubbles, inclusions, striae and granularity within the body of the material. The surface scattering results from scratches or other surface imperfections which cause the surface to deviate from an ideal plane.

The scattering measurements of this report do not differentiate between the types of scattering but simply combine them into a single scatter value. The scattering from the mirror surface which is due to surface roughness or particles was similarly lumped into one parameter called BRDF.

### Experimental Apparatus

The scattering experiment was performed on the scatter measurement instrument built and operated by the Optical Sciences Center at the University of Arizona. This device has a short optical bench that is capable of being rotated in a horizontal plane about a vertical axis. A gimbaled mount permits a sample to be centered on the optical-bench-rotational-axis and adjusted to various optional angles of incidence about both vertical and horizontal pivot axes. An adjacent platform supports a

laser and auxiliary optics so that a converging beam is incident on the sample. An appropriate detector is selected for the wavelength used and is mounted on the optical bench. The detector is aligned to face toward the sample and it detects the scattered radiation. The output signal of the detector is connected to a lock-in amplifier which derives its reference signal from a chopper installed in front of the laser. Baffles and apertures are used to block out stray radiation from the laser and off-angle reflections from the chopper blades. A schematic of the test setup is shown in Fig. 1.

Three laser sources were utilized for the scattering experiments: a 3 milliwatt helium-neon laser operating at 632.8 nanometers, a 4.5 milliwatt helium-neon laser operating at 3.391 micrometers, and a 3 watt carbon dioxide laser operating at 10.6 micrometers. In the case of the second laser, a long pass filter was mounted on the laser output to pass the 3.391 micrometer output but reject an undesired 1.15 micrometer output. For each laser, appropriate calibrated attenuators were placed in the beam to enable on-axis measurements. Each of the attenuators had a value between 10 and 20.

Three detectors were employed, one for each of the three lasers. A GaAsP photovoltaic detector with an operational amplifier used in the transimpedance configuration was utilized to detect the 632.8 nanometer radiation. A series of small apertures collinear with the detector limited the field of view to about 2 degrees. In order to be able to measure very low signals, provisions have been made for mounting a lens in front of the detector to increase the collecting numerical aperture. A lead sulfide photoconductive detector operating at dry ice temperature was utilized to detect the 3.391 micrometer radiation. The field of

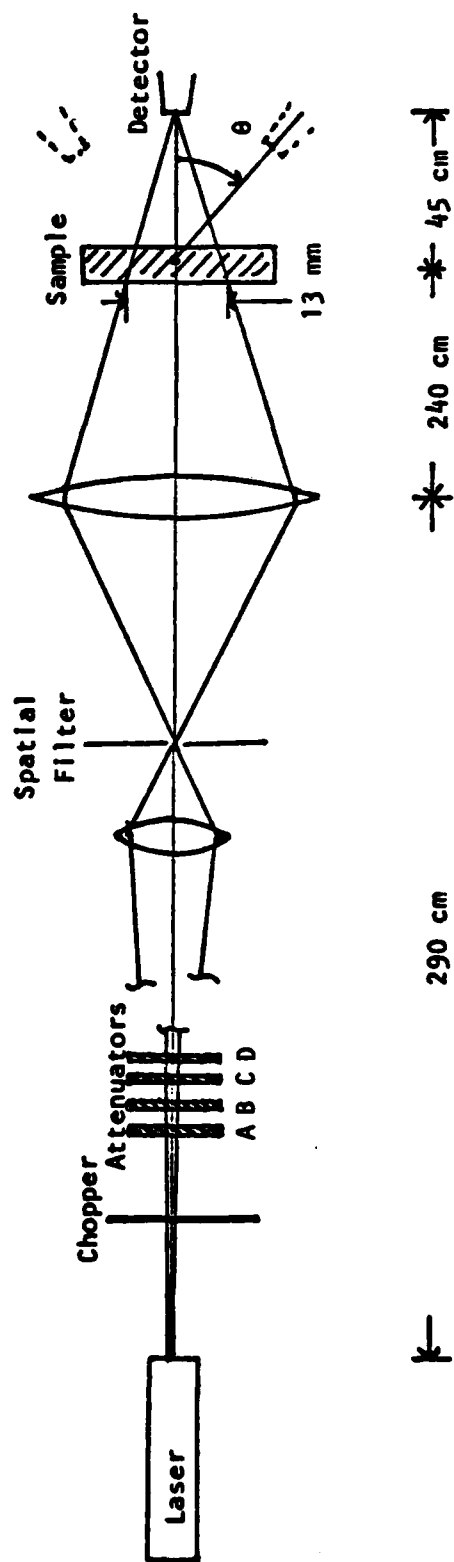


Figure 1. Optical Schematic of Scattering Instrument.

view of this detector was limited by a series of apertures similar to those used for the GaAsP detector, and again a lens attachment was provided. For the 10.6 micrometer band, a mercury-doped germanium photoconductor detector mounted in a liquid helium cooled dewar with a barium fluoride field lens was used.

All three laser-detector combinations were used with the lock-in amplifier, providing a dynamic range of 8 orders of magnitude. Noise fluctuations encountered at lower signal amplitudes were overcome by using longer integration times on the lock-in amplifier.

The angular position of the detector with respect to the sample was determined by a resolver with a digital angle readout. It is read within one minute of arc. The angular position of the sample in the horizontal plane was set with a smaller circular scale calibrated in one degree increments. The detectors were set to the appropriate height with a precision slide and lead screw after the laser was set to approximately the correct height.

#### Data Collection Procedure

The geometry of the measurement arrangement is shown in Fig. 2. The laser and detectors lie in the same horizontal plane. For zero degree incidence the sample is vertical and its surface is perpendicular to the direction of the laser beam. The incidence angle is changed by rotating the sample about the vertical axis through its front surface. The angle of measurement, the scatter angle, is determined by the position of the detector on a circle centered on the same vertical axis through the surface of the sample. The sample can also be tilted about a horizontal

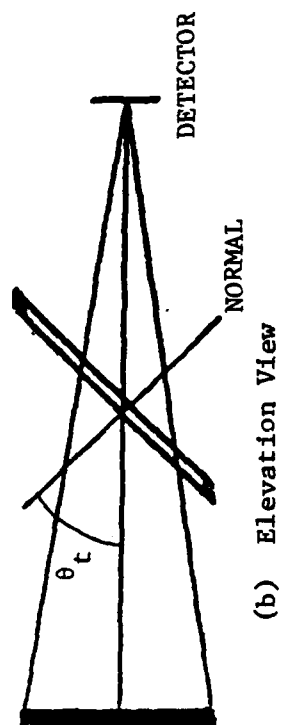
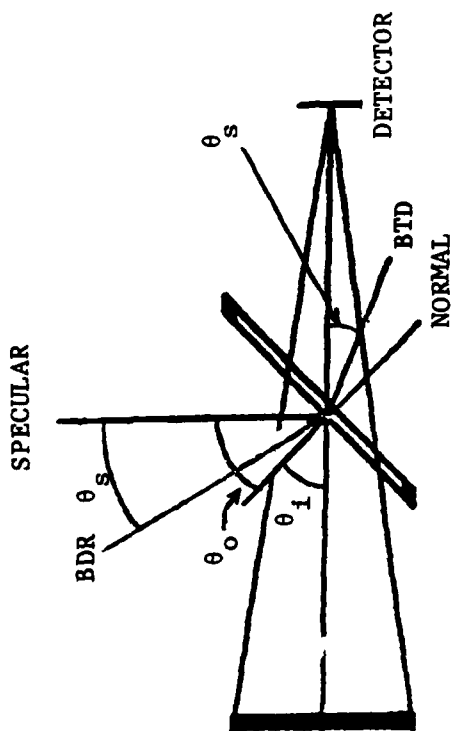


Fig. 2. Geometry of the scattering measurement. The angle  $\theta_i$  is the angle of incidence;  $\theta_o$  is that of specular reflection;  $\theta_s$ , the scattering angle of measurement;  $\theta_t$  is the tilt angle. Angles for both reflection and transmission are shown in (a).

axis through its front surface to obtain readings outside the plane of incidence.

The data taking procedure includes taking no-sample and sample runs. The former are done with everything in place except the sample so that the instrument background readings can be made. The procedure is identical for both types of run. The proper laser is chosen and aligned. The sample holder is set to the desired angles of incidence and tilt. All the attenuators are inserted and the detector is moved to an on-axis position by trial and error until its output is maximized. Then the reading is recorded, the angle recorders set to zero and a run started. The run consists of moving the detector to a series of positions at increasing angles from the on-axis position and removing attenuators as necessary. When the signals get low enough at the larger angles, a lens is inserted. It collected more flux over a large angle. Usually a run was terminated when the sample holder began to interfere with the measurements. Then attenuators were reinserted and the on-axis measurement repeated. Then a run was made with the detector moving in opposite direction and away from the axis. The on-axis measurement was again repeated. Then a new angle of incidence or tilt was chosen and the process was repeated.

#### Data Reduction

Two methods of data reduction are used, one for reflecting samples and one for transmitting samples. The methods are based on measured voltages and the definitions of BRDF and BTDF. When light is scattered from the sample the output voltage  $V$  is given in terms of the detector

responsivity  $\mathcal{R}$ , scattered radiance  $L$ , the sample area  $A_s$  and the solid angle the detector subtends at the sample  $\Omega$  as

$$V = \mathcal{R} L A \Omega$$

The BRDF is defined<sup>1</sup> as the reflected radiance divided by the incident irradiance. The BTDF may be defined similarly with "transmitted" replacing "reflected." Our generalization uses "scattered" to mean either one. Then if  $E$  is the irradiance and  $\rho_s$  is the BSDF (Bidirectional Scattering Distribution Function)

$$V = \mathcal{R} \rho_s E A \Omega \cos \theta_s$$

By definition  $\rho_s$  for the no-sample measurement is 1 so that the voltage ratio of sample  $V_s$  to no-sample  $V_{ns}$  is

$$\frac{V_s}{V_{ns}} = \rho_s \Omega \cos \theta_s$$

The BSDF is then found to be

$$\rho_s = V_s / V_{ns} \Omega \cos \theta_s$$

Goldplated sandpaper has been found to be a reasonably good Lambertian reference if it is illuminated at angles of incidence less than  $30^\circ$ .<sup>2</sup>

So if the subscript  $sp$  is used to indicate a sandpaper measurement, the voltage ratio is

$$\frac{V_s}{V_{sp}} = \frac{\mathcal{R} \rho_s E A \Omega \cos \theta_s}{\mathcal{R} \rho_{sp} E A \Omega \cos \theta_{sp}}$$

If the sandpaper has a hemispherical reflectivity of 0.92 and calibration of the scatterometer is done at  $\theta_{sp} = 0^\circ$  then

$$\rho_s = (V_s/V_{sp}) (0.92/\pi) (1/\cos\theta_s)$$

This is the basis of the sandpaper calibration, where  $\rho_s$  was determined independently.

#### Data Presentation

The data are presented in several ways. The abscissa is always a logarithmic scale. It is either the scattering angle  $\theta_s$  or it is a quantity called B-BO (or  $\beta-\beta_0$ ) where  $B-BO = \sin\theta_s - \sin\theta_i$ . There are theoretical reasons<sup>3</sup> for plotting in this second coordinate system. The ordinate is always a logarithmic one and is either the BRDF or a slightly modified BTDF, one that is normalized to the on-axis value for the sample. If we did not use this normalization, thicker samples of the same material would have lower BTDF values just because their specular transmission would be lower.

The ordinates are labeled "BRDF" or "BTDF." The sample, wavelength and angle of incidence and tilt are listed on each graph and for the tabular listing following the graph. The angle of incidence is measured in the customary way, with respect to the surface normal. The scattering angle is however, referred to the direction of specular reflection. This provides a similar appearance for all the curves. The scattering angle can be positive or forward (further from the normal) of the specular direction or it can be negative or backward (between the normal and the



specular direction or even on the same side of the normal as the incident light).

The scatter plot is a convolution of the detector field of view of the laser beam profile and the scattered radiation. In fact, the scattered component can be obtained by subtracting the normalized no-sample data from the normalized sample data on a point-by-point basis. The accuracy of the resulting subtracted data is satisfactory at larger angles where the no-sample values are small. However at smaller angles where the data are comparable in size, the very small difference between two large numbers would yield considerable uncertainty. Deconvolution by subtraction was therefore not performed and the data taken at detector angles of less than two degrees contain a significant contribution from the beam profile.

The data at each of the three wavelengths were taken at six different input angles consisting of various combinations of two different incidence angles ( $\theta_i$ ) and three different tilt angles ( $\theta_t$ ). All combinations for which  $\theta_i = 0^\circ$  and  $15^\circ$  and  $\theta_t = 0^\circ$ ,  $15^\circ$  and  $30^\circ$  were measured, for three thicknesses of Raytran ZnSe samples,  $1/4"$ ,  $3/4"$ , and  $1"$ .

The purpose of measuring the so-called "super" mirror was to demonstrate as closely as possible the quality of the unperturbed incident beam when the components of the instrument were arranged for measuring BRDF. After the measurements were completed we carefully examined the mirror under magnification and feel doubts that our so-called "super" mirror was really "super." The "no-sample" measurements are actually a better indication of the instrument function. They represent the

scattering of a plane parallel plate of air about as thick as each sample, as measured by the instrumentation.

#### Summary

Data are presented with an accuracy of about  $\pm 20\%$  to a level of about  $10^{-6} \text{ sr}^{-1}$ . Improvements in instrumentation and software could make the measurements more standardized, the accuracy better and the minimum values lower. Some of the same improvements could be used to make the spectral selection more flexible.

The ZnSe data are presented in the following manner: For each of the three sample thicknesses, three wavelengths, two incident angles  $\theta_i$ , and three tilt angles  $\theta_t$ , a graph of BTDF versus scattering angle  $\theta_s$  (both positive and negative) is given, followed by the corresponding data table(s). These add up to a total of fifty-four graphs. These graphs and corresponding data table(s) are given on pages 13-138.

The above parameters for each graph and table are denoted, for example, by "Sample - ZnSe 1/4 (0,15) 6328." This means: Sample thickness = 1/4."  $\theta_i = 0$ ,  $\theta_t = 15^\circ$ , and  $\lambda = 0.6328 \text{ }\mu\text{m}$ .

Following the data for ZnSe are presented five graphs for the case of no sample: one graph for  $0.6328 \text{ }\mu\text{m}$ , one graph for  $3.39 \text{ }\mu\text{m}$ , and three graphs for  $10.6 \text{ }\mu\text{m}$ , where the last three graphs were taken on three different days. These five graphs are on pages 139-143.

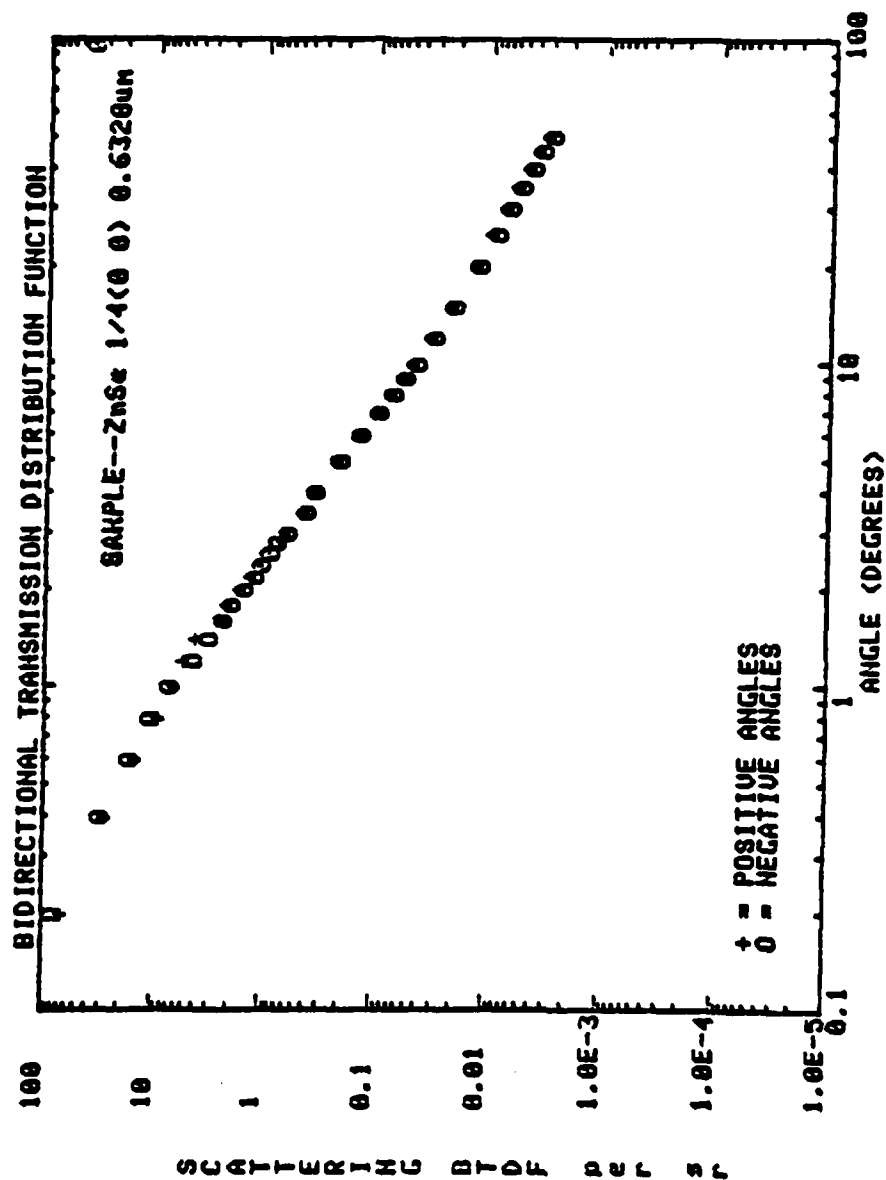
Lastly, the graphs and data tables for the "super mirrors" are presented on pages 144-157.

### Acknowledgments

We appreciate the efforts of Larry Brooks in building the new goniometer on which the 10.6  $\mu\text{m}$  measurements were made.

#### REFERENCES

1. F. E. Nicodemus and J. C. Richmond, Geometrical Considerations and Nomenclature for Reflectance, U. S. Department of Commerce, 1977.
2. T. W. Stuhlinger, Bidirectional Reflectance Distribution Function (BRDF) of Gold-plated Sandpaper, Optical Sciences Center, University of Arizona, Tucson, MS Thesis, 1981.
3. P. Beckmann and A. Spizzichino, Scattering of Waves from Rough Surfaces, Pergamon, 1963.



SAMPLE--ZnSe 1/4(0 0) 0.6328um

2/6/80

ANGLE  
0 0.2 0.4 0.6 0.8 1 1.2 1.4 1.6 1.8 2 2.2 2.4 2.6 2.8 3 3.5 4 5 6 7 8 9 10 12 15 20 25 30 35 40 45 50

BTDF DATA

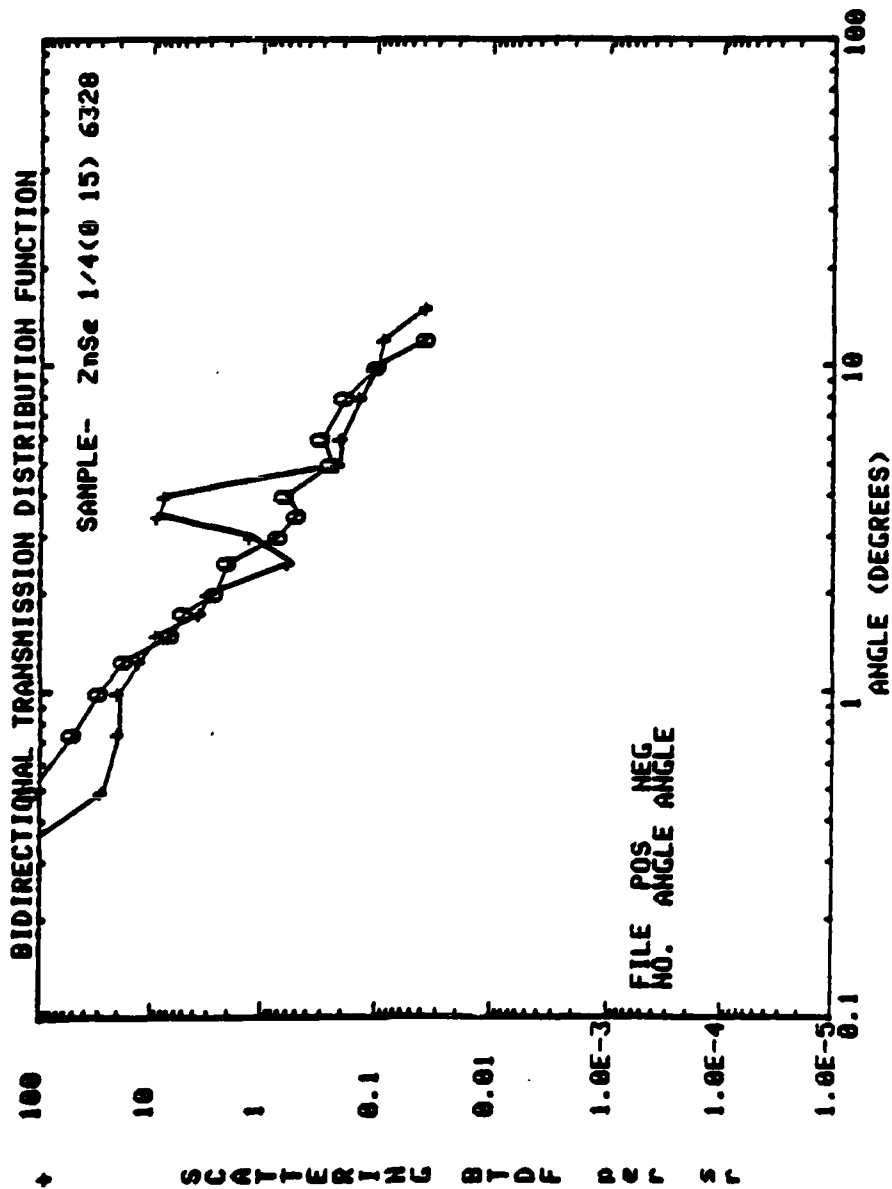
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3.92805251235  
2.28647839174  
2.05196785219  
1.56242780541  
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1.0904744718  
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0.733637291386  
0.612207703691  
0.425003759209  
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0.0217616361105  
0.013316930222  
0.00953051470743  
0.0072926046531  
0.0057654770608  
0.0046449402723  
0.00301672507521  
0.00313465605243

ANGLE

0 -0.2 -0.4 -0.6 -0.8 -1 -1.2 -1.4 -1.6 -1.8 -2 -2.2 -2.4 -2.6 -2.8 -3 -3.5 -4 -5 -6 -7 -8 -9 -10 -12 -15 -20 -25 -30 -35 -40 -45 -50

BTDF DATA

166666.666667  
77.1082864897  
29.0177828865  
15.5306445059  
10.2175294129  
6.94792011684  
4.65928911471  
2.94709709959  
2.25202709162  
1.83498509551  
1.44296560326  
1.1454756295  
0.978658832028  
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0.130962529264  
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0.0683283649023  
0.0533815771837  
0.0427052993927  
0.030355658296  
0.020237058041  
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0.00871021007711  
0.00676047662098  
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SAMPLE - ZnSe 1/4(0 15).6328um

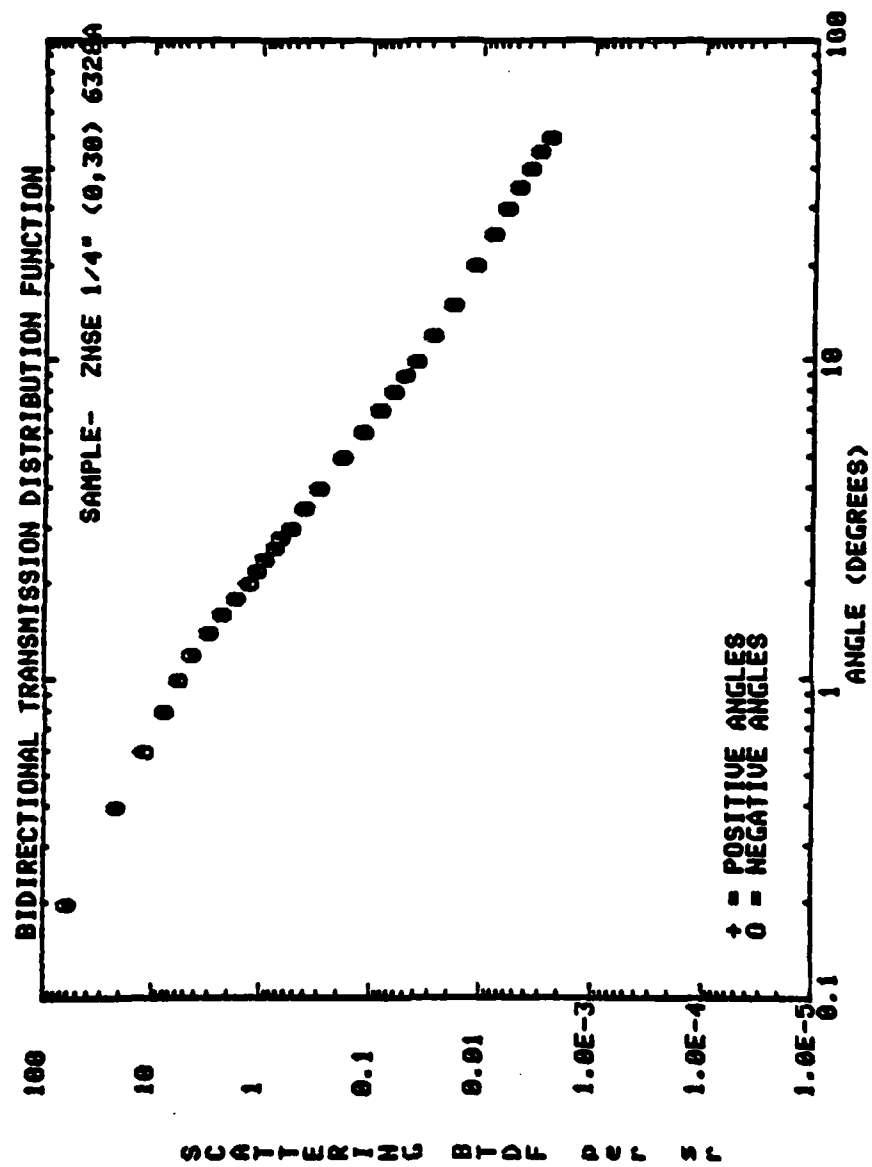
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1	19.0202309378
1.25	12.3876446594
1.5	8.67135153818
1.75	3.46854074603
2	2.97303505448
2.5	0.569831778261
3	1.2387648934
3.5	0.67135556134
4	7.4325917743
5	0.210590180207
6	0.198202631231
8	0.13626448599
10	0.0991016098815
12	0.0867140856666
15	0.0371633192342
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-12	0.0371631795714
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-6	0.297303946846
-5	0.247753162596
-4	0.619382647859
-3.5	0.495506032076
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-2.5	1.982023357656



SAMPLE - ZnSe 1/4 (0 15) .6328  $\mu$ m

ANGLE  
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-1.5  
-1.25  
-1  
-0.75  
-0.5  
-0.25  
0

BIDF DATA  
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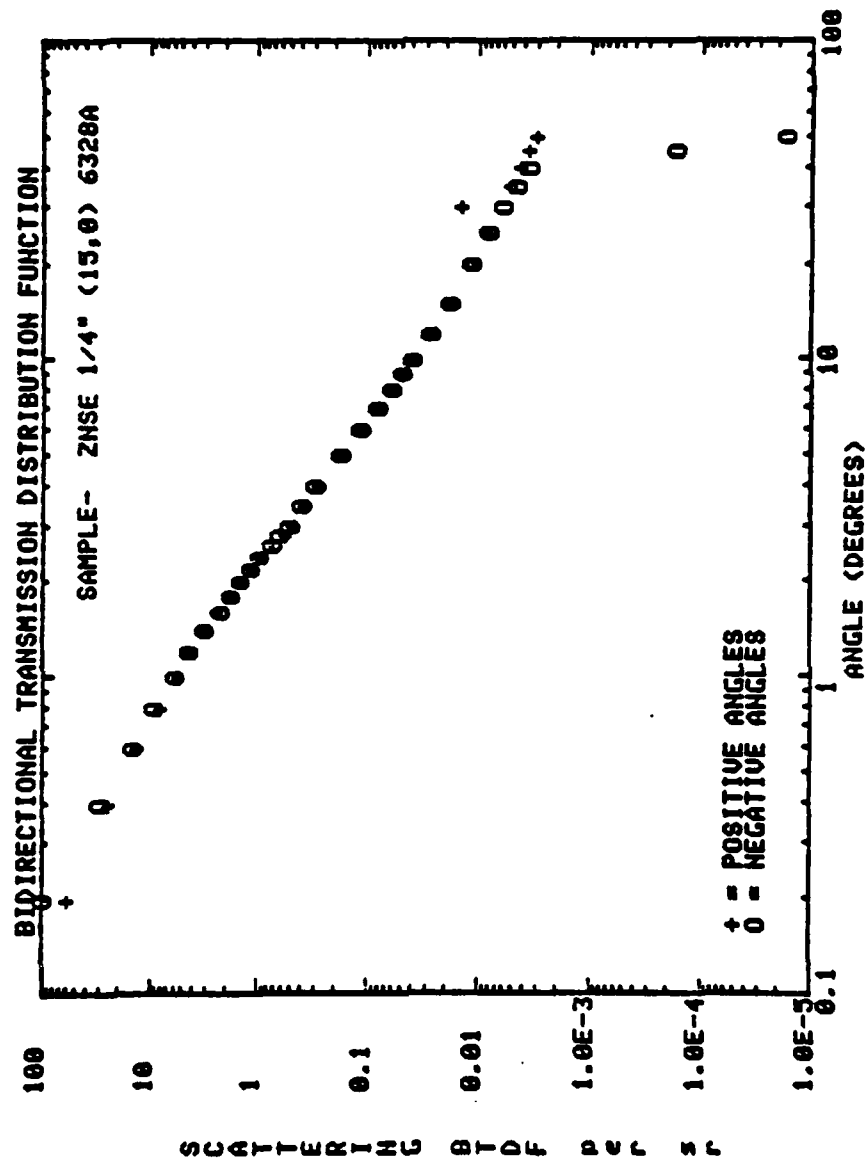


SAMPLE-ZNSE 1/4" I-0 T-30 6328A 2/11/80

ANGLE

BTDF DATA

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0.4	21.5736042211
0.6	12.5606319075
0.8	8.1934576601
1	5.78482824358
1.2	3.82916347071
1.4	2.67625517851
1.6	2.16159078127
1.8	1.66102675843
2	1.33107751719
2.2	1.09419086305
2.4	0.854484153903
2.6	0.714326225167
2.8	0.599266597449
3	0.508178441187
3.2	0.396345402928
3.4	0.29094212235
3.6	0.174789734512
3.8	0.115510627224
4	0.0860574878257
4.2	0.0606459781606
4.4	0.0476172122255
4.6	0.0383109504485
4.8	0.0266781252191
5	0.0176820796773
5.2	0.0110281234449
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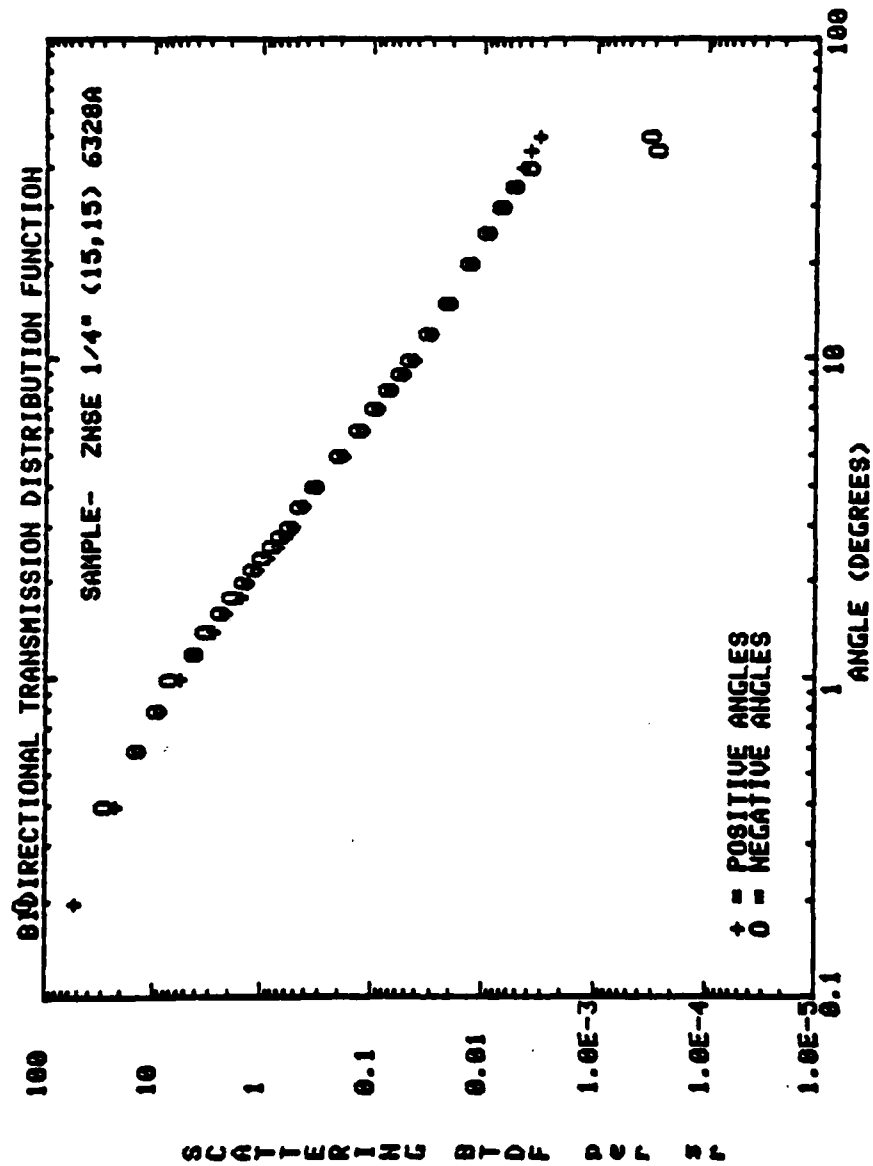
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1.2  
1.4  
1.6  
1.8  
2  
2.2  
2.4  
2.6  
2.8  
3  
3.5  
4  
5  
6  
7  
8  
9  
10  
12  
15  
20  
25  
30  
35  
40  
45  
50

BTDF DATA  
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ANGLE  
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-0.2  
-0.4  
-0.6  
-0.8  
-1  
-1.2  
-1.4  
-1.6  
-1.8  
-2  
-2.2  
-2.4  
-2.6  
-2.8  
-3  
-3.5  
-4  
-5  
-6  
-7  
-8  
-9  
-10  
-12  
-15  
-20  
-25  
-30  
-35  
-40  
-45  
-50

BTDF DATA  
166666.666667  
94.2402404151  
27.9759761837  
14.0900903254  
8.84954981232  
5.65976002235  
4.12132159667  
2.9357360027  
2.11711736057  
1.67957983206  
1.36636661994  
1.1141143643  
0.921922168297  
0.709609832169  
0.602402621523  
0.49519540197  
0.375920141587  
0.279663270221  
0.167591785981  
0.111471657657  
0.0791833631984  
0.0594596360151  
0.0470722409726  
0.0379881642373  
0.0264266029826  
0.0175076962713  
0.0111158219063  
0.00779602185929  
0.00573147055456  
0.0041016055804  
0.00341917273266  
1.651866839E-4  
1.651843245E-5



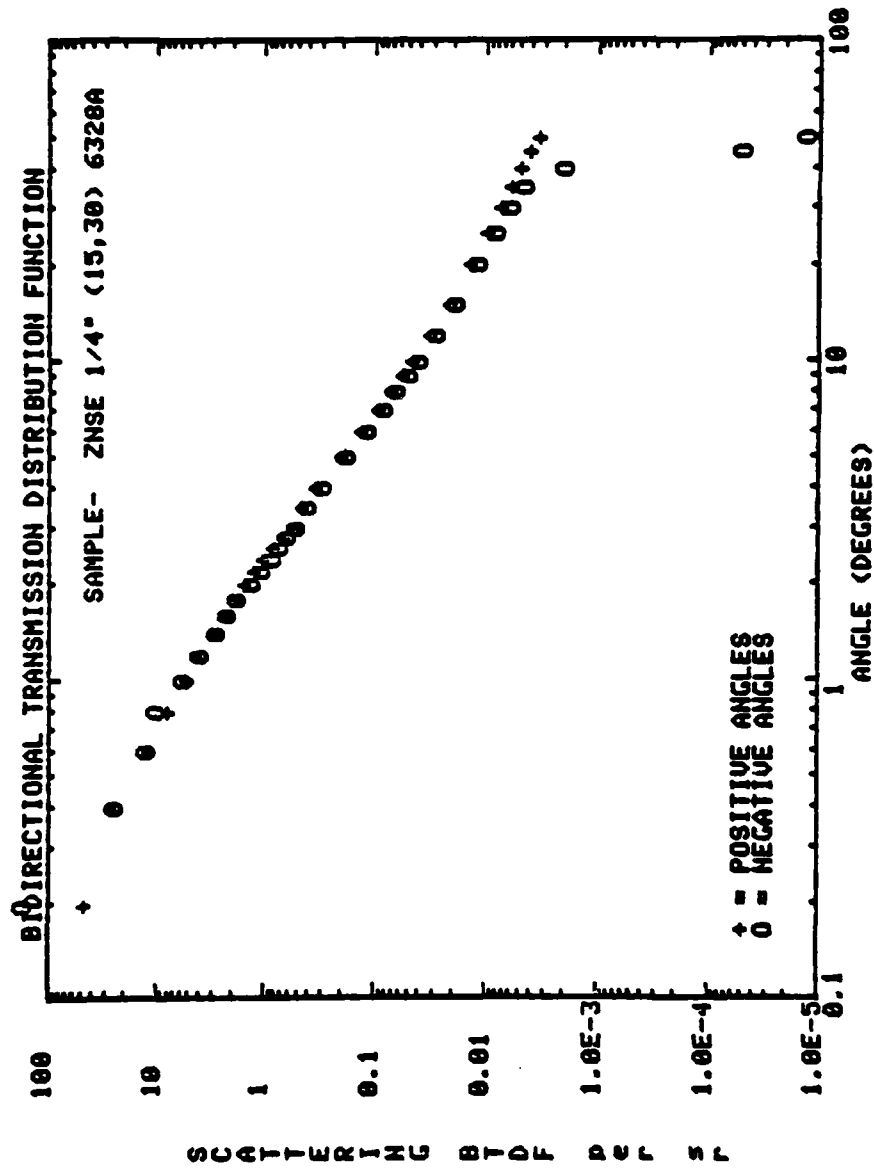
SAMPLE-ZNSE 1/4" INC-15, TILT-15 6320 A 2/11/80

ANGLE  
0 0.2 0.4 0.6 0.8 1 1.2 1.4 1.6 1.8 2 2.2 2.4 2.6 2.8 3 3.5 4 5 6 7 8 9 10 12 15 20 25 30 35 40 45 50

BTDF DATA  
166666.666667  
50.6300115487  
21.4203896206  
12.5601376668  
0.08906095039  
5.27605980951  
4.22623166830  
2.61111134856  
2.04581925788  
1.48052714123  
1.27720527712  
1.65097389007  
0.839060934426  
0.696162875845  
0.579324300256  
0.4868272365  
0.390744781072  
0.302772275159  
0.175212116172  
0.117256874037  
0.0835740731586  
0.065363882510  
0.050860988797  
0.0406359273655  
0.0289807205389  
0.019530558978  
0.0121594467354  
0.00871016093302  
0.00669415122778  
0.00533965055499  
0.00441040737805  
0.0037174168351  
0.0031109184565

ANGLE  
0 -0.2 -0.4 -0.6 -0.8 -1 -1.2 -1.4 -1.6 -1.8 -2 -2.2 -2.4 -2.6 -2.8 -3 -3.5 -4 -5 -6 -7 -8 -9 -10 -12 -15 -20 -25 -30 -35 -40 -45 -50

BTDF DATA  
166666.666667  
147.962963238  
27.2839508198  
13.6419755365  
8.04876569485  
6.89043241845  
4.03271631881  
3.26586446906  
2.30648175543  
1.79876570249  
1.39814840762  
1.15432124686  
0.962963220306  
0.78703728388  
0.64537060512  
0.54043232443  
0.432197776584  
0.316839741374  
0.191216098327  
0.127216089016  
0.093234779861  
0.0697687256853  
0.0544909455212  
0.044136072419  
0.03039552681397  
0.0265403378785  
0.0128944983736  
0.0090311260757  
0.00675545496209  
0.00517776341099  
0.0038197279924  
2.71630158E-4  
3.08677701E-4





SAMPLE-ZNSE 1/4" INC=15, TILT=30 6328A 2/11/80

ANGLE  
0 0.2 0.4 0.6 0.8 1 1.2 1.4 1.6 1.8 2 2.2 2.4 2.6 2.8 3 3.5 4 5 6 7 8 9 10 12 15 20 25 30 35 40 45 50

BTDF DATA

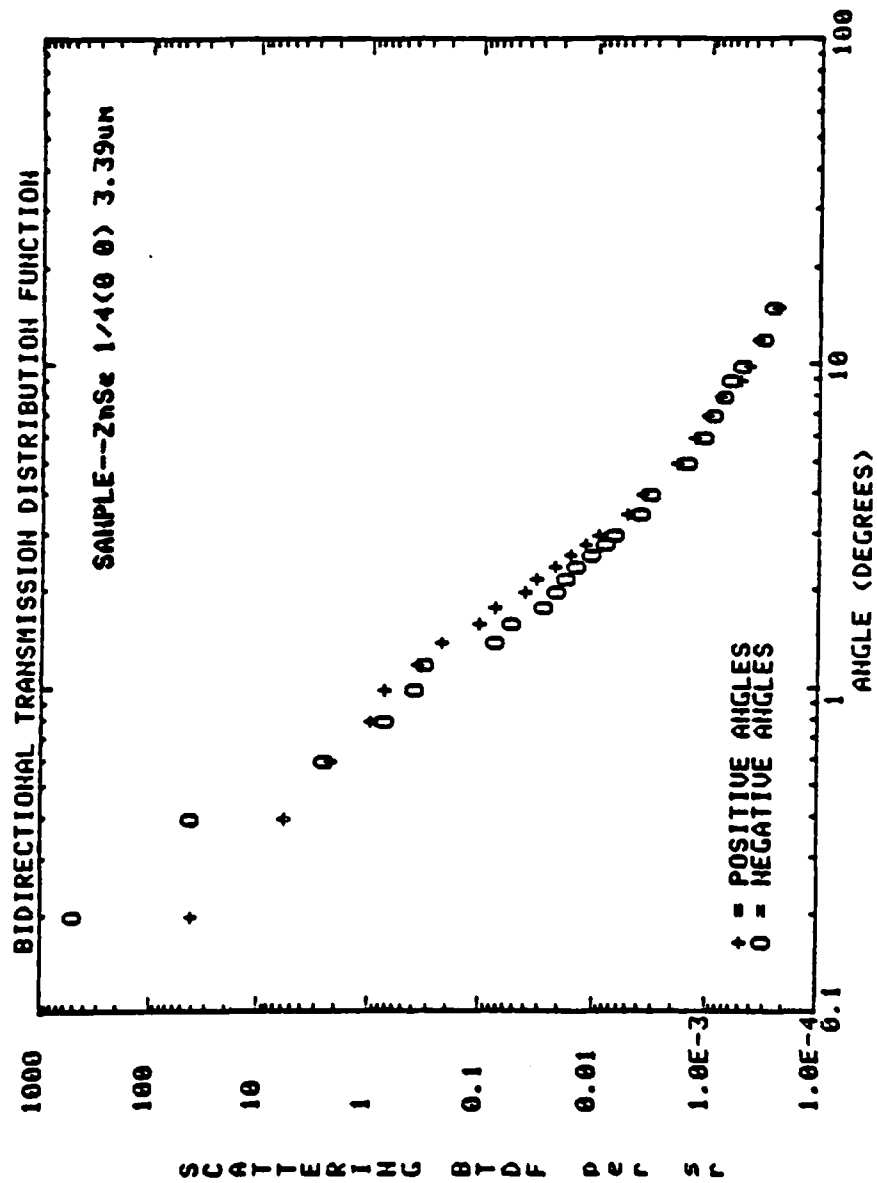
166666.666667  
44.8484849317  
25.3535355417  
11.4141416048  
7.48425453002  
4.90484871612  
4.06328012887  
2.69489032231  
2.15032705279  
1.68954273764  
1.45870496471  
1.17944173841  
0.974450646628  
0.80303055489  
0.636363867837  
0.530303251738  
0.428948550388  
0.323993110386  
0.191657976314  
0.127772049419  
0.0985652562595  
0.0702616465389  
0.6550655664171  
0.0444446506492  
0.0307191594831  
0.0205084502181  
0.0131701790566  
0.03921595351217  
0.0070754588416  
0.0056375753103  
0.00467354954364  
0.0030392542651  
0.00323566941477

ANGLE

0 -0.2 -0.4 -0.6 -0.8 -1 -1.2 -1.4 -1.6 -1.8 -2 -2.2 -2.4 -2.6 -2.8 -3 -3.5 -4 -5 -6 -7 -8 -9 -10 -12 -15 -20 -25 -30 -35 -40 -45 -50

BTDF DATA

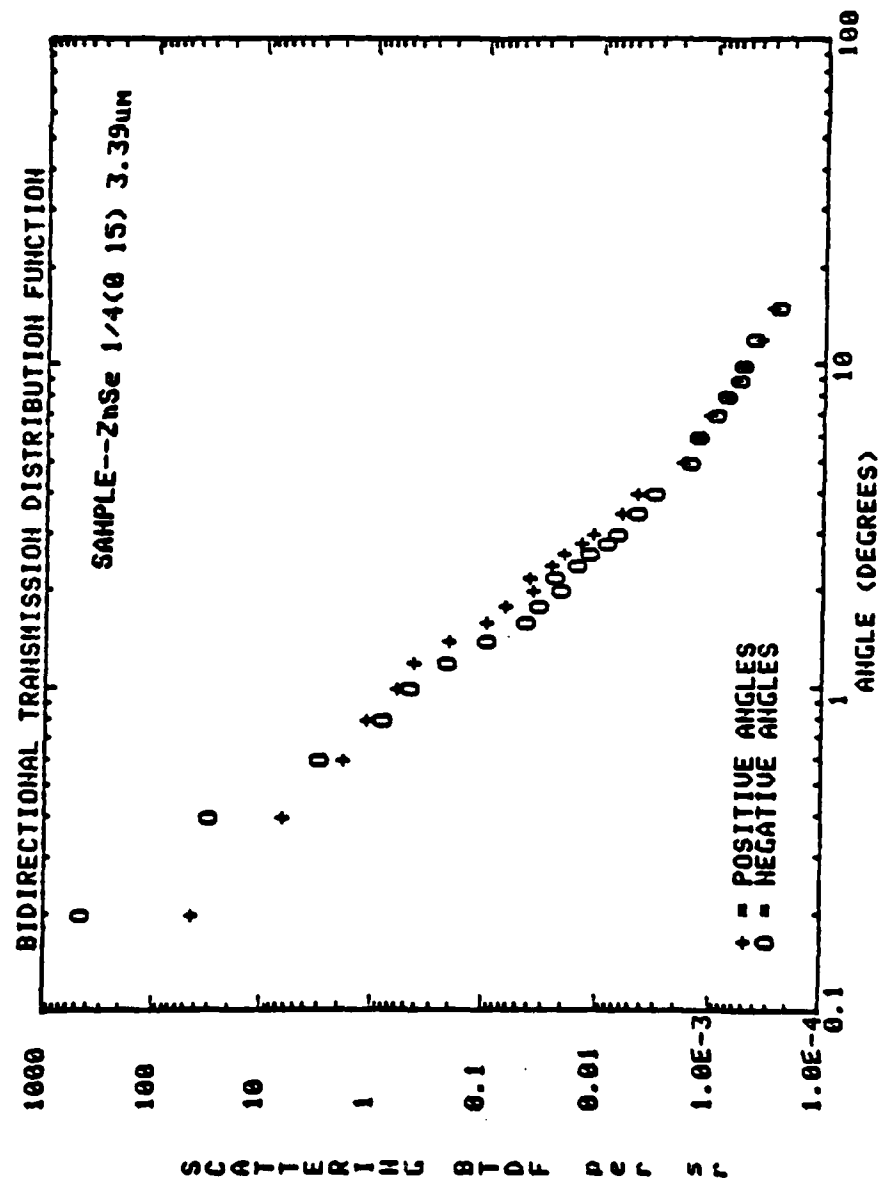
166666.666667  
163.040935975  
24.1578949162  
12.1286551733  
9.06725175498  
5.46087744356  
3.79298270955  
2.72165287902  
2.13011721207  
1.74532185979  
1.26900208346  
1.04093598626  
0.815789691696  
0.715789698182  
0.59649144504  
0.497076230952  
0.352228294803  
0.284444655597  
0.174409559822  
0.115275046339  
0.0823393684767  
0.0635235804357  
0.0493715305706  
0.0402048640965  
0.0275001037287  
0.010333524718  
0.0114183405599  
0.0679125101431  
0.06577363289672  
0.00435843404363  
0.00191380476251  
4.025014715E-5  
1.286698549E-5



SAMPLE--ZnSe 1/4(0 0) 3.39um

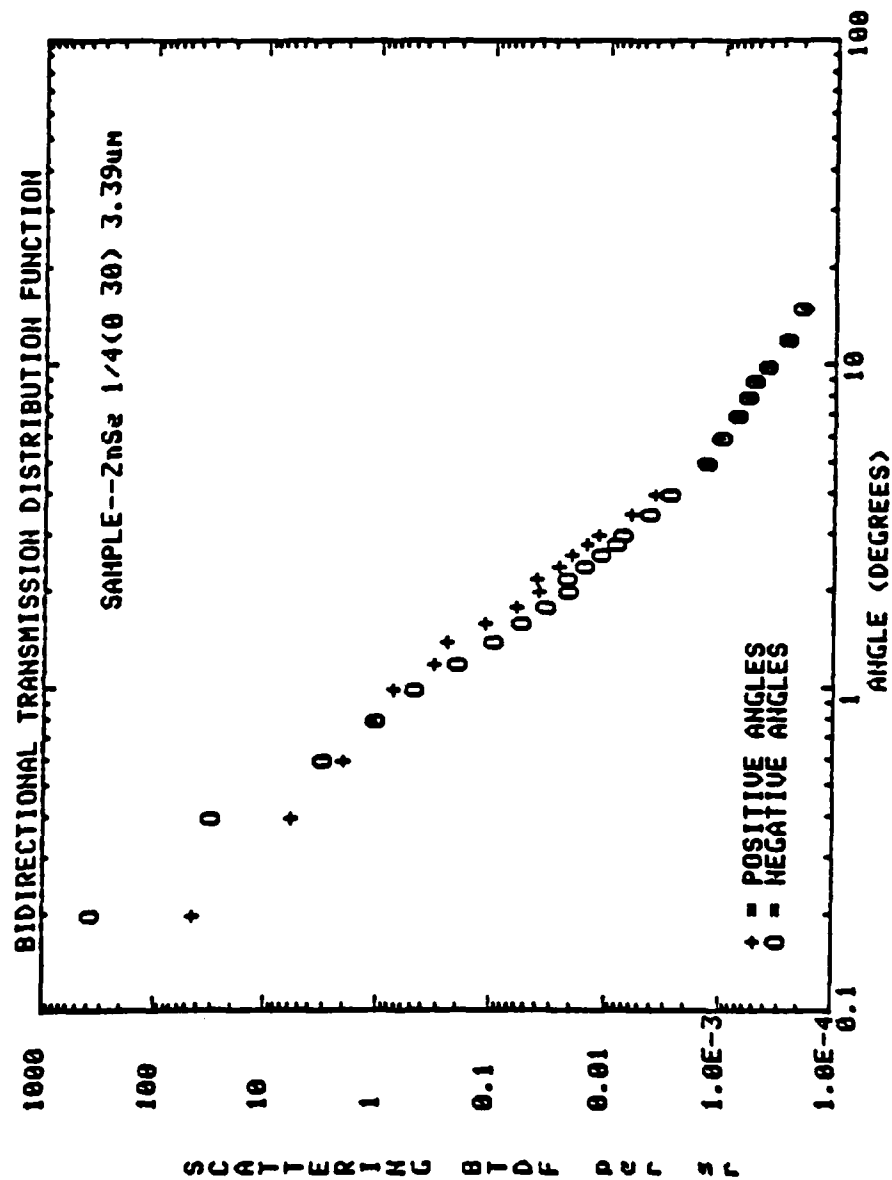
ANGLE	BTDF DATA	ANGLE	BTDF DATA
0	100084.692454	0	93829.3991756
0.2	39.325680054	-0.2	486.132342795
0.4	5.4386578793	-0.4	40.1623966509
0.6	2.09179149223	-0.6	2.42647813099
0.8	0.920388256532	-0.8	0.70284194139
1	0.70284194139	-1	0.376522468602
1.2	0.351420970695	-1.2	0.30958514085
1.4	0.217546315132	-1.4	0.0711209107359
1.6	0.100405991627	-1.6	0.0510397124105
1.8	0.0719576273328	-1.8	0.0267749311006
2	0.0384889634571	-2	0.0209179149223
2.2	0.0307911707657	-2.2	0.0173200335557
2.4	0.0211689299014	-2.4	0.0138560268445
2.6	0.0157804750174	-2.6	0.0101995753161
2.8	0.0115466890371	-2.8	0.00769779269141
3	0.00885246159513	-3	0.00635067897042
3.5	0.00500356524942	-3.5	0.003384889634571
4	0.00365645152842	-4	0.00307911707657
5	0.00178973680075	-5	0.00146258061137
6	0.00127013579408	-6	0.00103920201334
7	9.814685662E-4	-7	8.660016778E-4
8	7.697792691E-4	-8	7.12045824E-4
9	5.003565249E-4	-9	6.158234153E-4
10	4.23378599E-4	-10	4.811120432E-4
12	3.464006711E-4	-12	3.079117077E-4
15	2.309337807E-4	-15	2.501782625E-4

COPY? (Y or N) Y



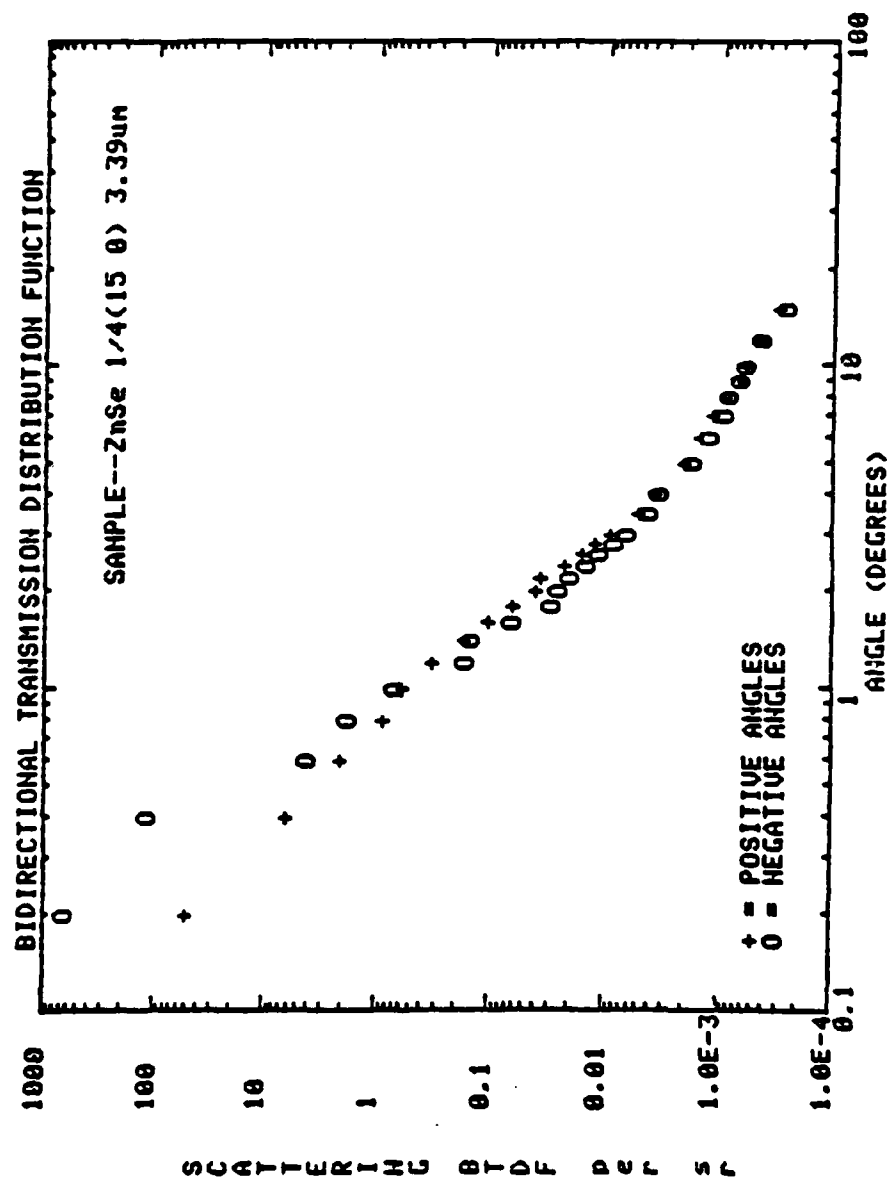
SAMPLE--ZnSe 1/4(0 15) 3.39um

ANGLE	BTDF DATA	ANGLE	BTDF DATA
0	95914.496935	0	97999.5946945
0.2	41.8358298446	-0.2	443.911623316
0.4	6.19170281701	-0.4	29.2850808913
0.6	1.75710485348	-0.6	2.84483642944
0.8	1.08773157596	-0.8	0.786513601079
1	0.577334451856	-1	0.443459796353
1.2	0.418358298446	-1.2	0.209179149223
1.4	0.200811983254	-1.4	0.0920388256582
1.6	0.0920388256582	-1.6	0.0418358298446
1.8	0.0635904613639	-1.8	0.0326319472788
2	0.0359780136664	-2	0.0209179149223
2.2	0.0384689634571	-2.2	0.0230933780742
2.4	0.0250178262471	-2.4	0.0230933780742
2.6	0.0192444817285	-2.6	0.0150106957483
2.8	0.01347113721	-2.8	0.0115466890371
3	0.010776909768	-3	0.00808268232599
3.5	0.00596578933585	-3.5	0.0065431237877
4	0.00442623079756	-4	0.00442623079756
5	0.00177049231903	-5	0.00307911707657
6	0.00132786923927	-6	0.00153955853828
7	0.00100071304988	-7	0.00128933027581
8	7.312903057E-4	-8	9.044906412E-4
9	6.158234153E-4	-9	7.505347874E-4
10	5.196010067E-4	-10	5.773344519E-4
12	3.656451528E-4	-12	5.388454884E-4
15	2.886672259E-4	-15	4.23378598E-4
			2.501782625E-4



SAMPLE--ZnSe 1/4 (0,30) 3.39um

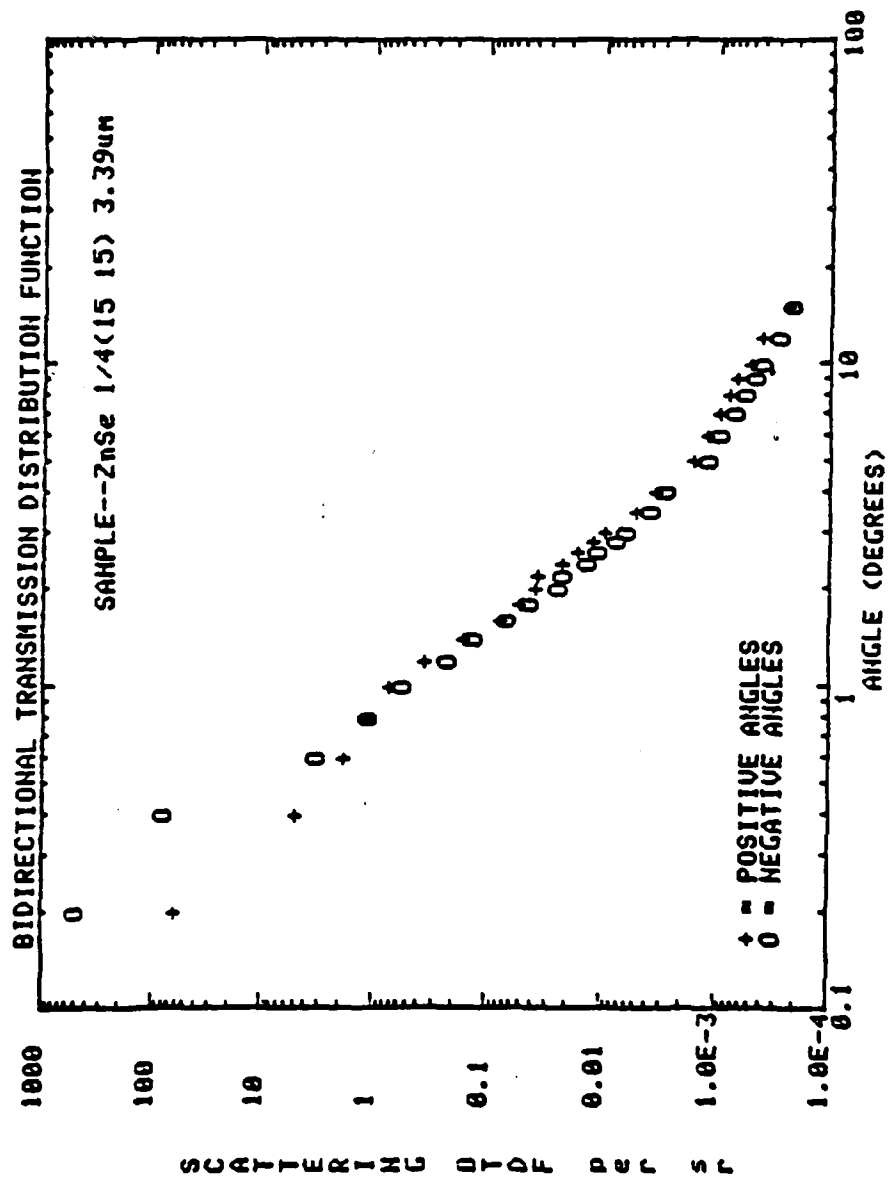
ANGLE	BTDF DATA	ANGLE	BTDF DATA
0	95914.496935	0	102169.790213
0.2	41.8358298446	-0.2	357.294721205
0.4	5.68967285887	-0.4	29.2850808913
0.6	1.92444817285	-0.6	2.92850808913
0.8	1.08773157596	-0.8	1.00405991627
1	0.70284194139	-1	0.451826962322
1.2	0.30958514085	-1.2	0.192444817285
1.4	0.23428064713	-1.4	0.0920308256582
1.6	0.108773157596	-1.6	0.0527131456043
1.8	0.0577334451856	-1.8	0.03263194722788
2	0.0368155302633	-2	0.0209179149223
2.2	0.0384889634571	-2.2	0.0211689299014
2.4	0.0250178262471	-2.4	0.014818250931
2.6	0.0192444817285	-2.6	0.010776909768
2.8	0.0142409164791	-2.8	0.0078902375087
3	0.0111617994026	-3	0.00692801342227
3.5	0.00577334451856	-3.5	0.00404134116299
4	0.00365645152842	-4	0.002694227442
5	0.00132786923927	-5	0.00128938027581
6	0.00101995753161	-6	9.622240364E-4
7	7.312903057E-4	-7	7.12045824E-4
8	5.773344519E-4	-8	5.773344519E-4
9	4.811120432E-4	-9	5.003565249E-4
10	4.041341163E-4	-10	3.848896346E-4
12	2.501782625E-4	-12	2.501782625E-4
15	1.732003356E-4	-15	1.924448173E-4





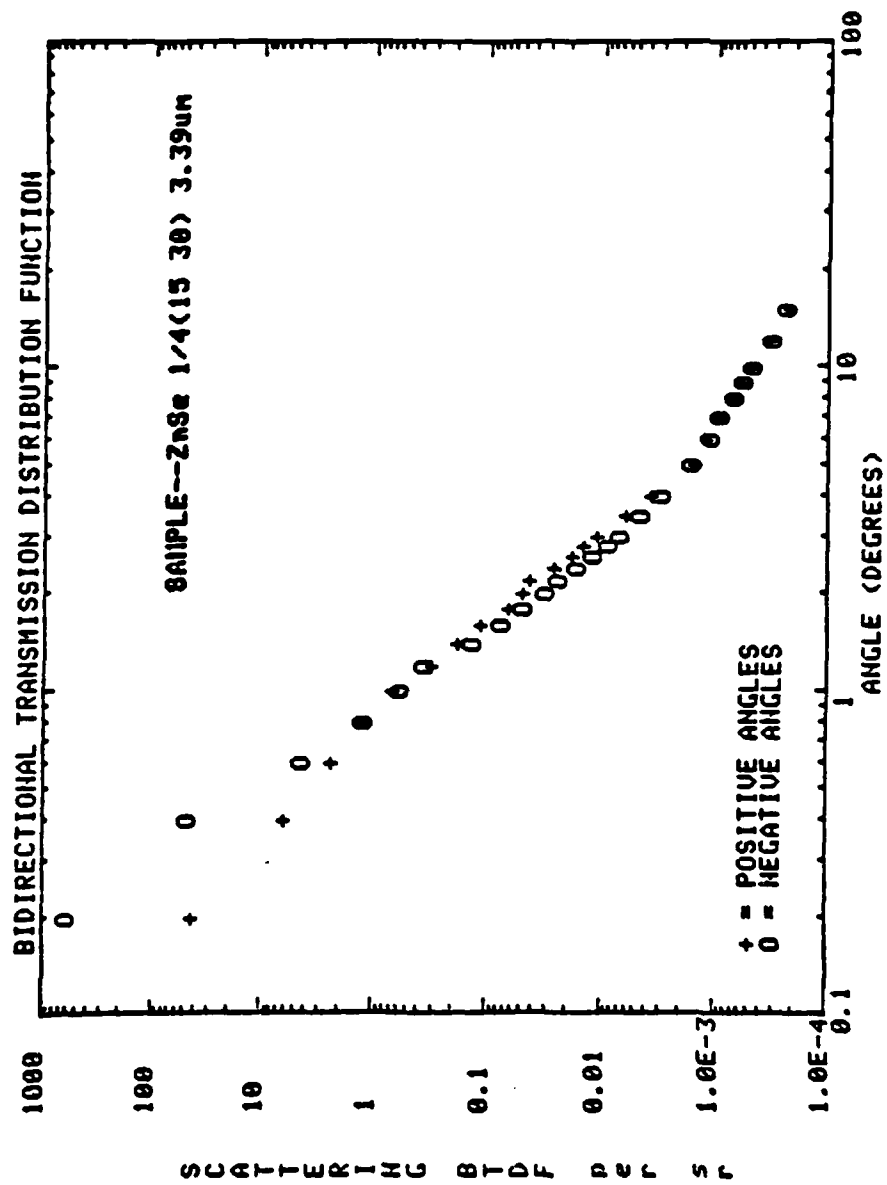
SAMPLE--ZnSe 1/4(15 0) 3.39um

ANGLE	BTDF DATA	ANGLE	BTDF DATA
0	85489.0081377	0	89659.2036367
0.2	48.194875981	-0.2	625.027297879
0.4	6.02435949763	-0.4	112.454710622
0.6	2.00811983254	-0.6	4.01623966509
0.8	0.836716596893	-0.8	1.75710485348
1	0.568967285887	-1	0.69373277514
1.2	0.30958514085	-1.2	0.15897615341
1.4	0.15897615341	-1.4	0.142241821472
1.6	0.100405991627	-1.6	0.062753744767
1.8	0.0610903115732	-1.8	0.0276116476975
2	0.0376522468602	-2	0.0242647813099
2.2	0.0346400671114	-2.2	0.0192444817285
2.4	0.0211689299014	-2.4	0.0138560268445
2.6	0.0150106957483	-2.6	0.010776909768
2.8	0.0115466890371	-2.8	0.0078902375087
3	0.00846757196056	-3	0.00615823415313
3.5	0.00481112043213	-3.5	0.00404134116299
4	0.00346400671114	-4	0.00327156189385
5	0.00192444817285	-5	0.00169351439211
6	0.00140404716618	-6	0.00119315786717
7	0.00111617994026	-7	9.044906412E-4
8	0.467571961E-4	-8	8.082682326E-4
9	6.35067897E-4	-9	6.35067897E-4
10	5.580899701E-4	-10	5.773344519E-4
12	4.641341163E-4	-12	4.23370598E-4
15	2.886672259E-4	-15	2.501782625E-4



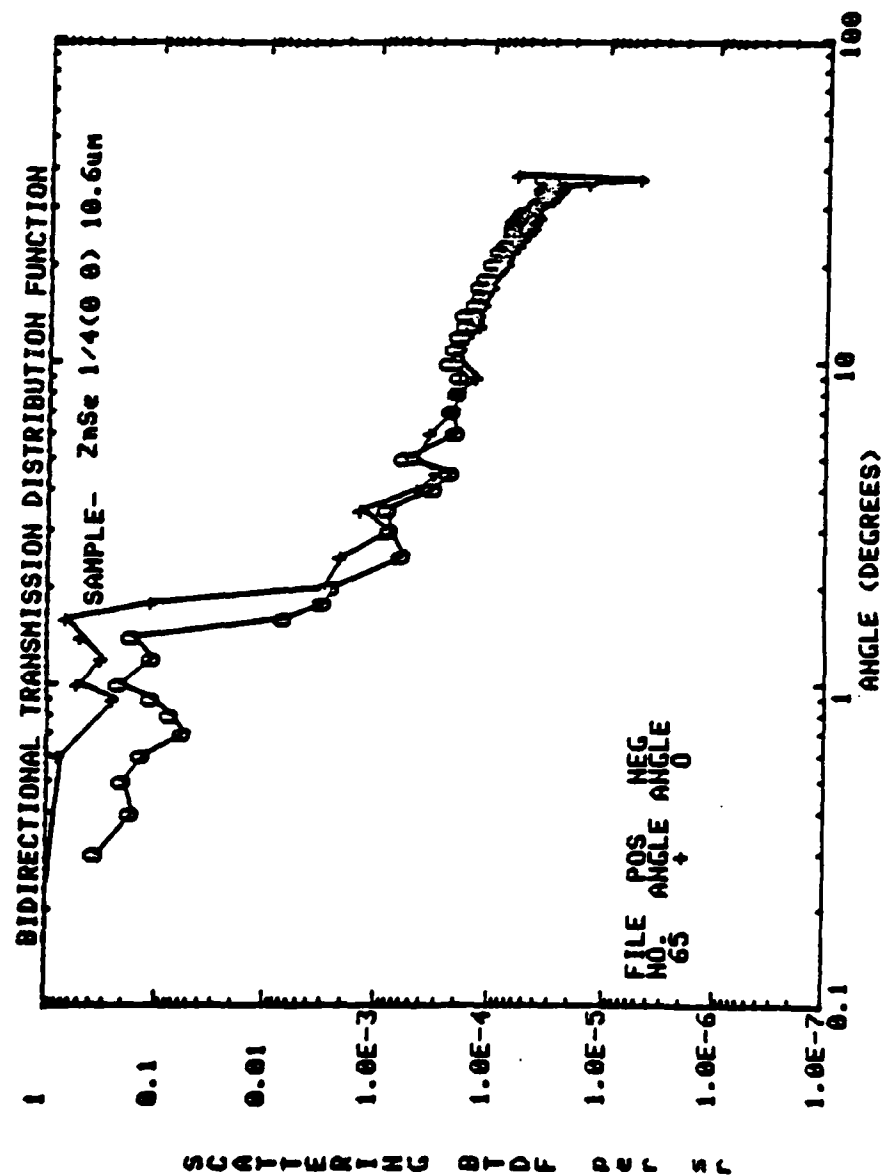
SAMPLE--ZnSe 1/4(15 15) 3.39um

ANGLE	BTDF DATA	ANGLE	BTDF DATA
0	93829.3991756	0	93829.3991756
0.2	58.9048484213	-0.2	476.392961607
0.4	4.6856129426	-0.4	77.6473001917
0.6	1.75710485348	-0.6	3.0958514085
0.8	1.08773157596	-0.8	1.08773157596
1	0.70284194139	-1	0.54386578798
1.2	0.334686638757	-1.2	0.217546315192
1.4	0.150608987441	-1.4	0.125507489534
1.6	0.0727943439297	-1.6	0.0652638945576
1.8	0.0502029558136	-1.8	0.0418258298446
2	0.0359788136664	-2	0.023428064713
2.2	0.0346400671114	-2.2	0.0211689299014
2.4	0.0211689299014	-2.4	0.0128938027581
2.6	0.0157804750174	-2.6	0.0103920201334
2.8	0.0115466890371	-2.8	0.00731290305684
3	0.00904490641241	-3	0.00596578933585
3.5	0.00481112043213	-3.5	0.00365645152842
4	0.00327156189385	-4	0.002694227442
5	0.00153955853828	-5	0.00115466890371
6	0.00115466890371	-6	9.23735123E-4
7	9.044906412E-4	-7	6.543123788E-4
8	7.312903057E-4	-8	5.388454884E-4
9	6.35667897E-4	-9	4.426230798E-4
10	4.811120432E-4	-10	3.848896346E-4
12	3.848896346E-4	-12	2.694227442E-4
15	2.369337807E-4	-15	2.11689299E-4



SAMPLE--ZnSe 1/4(15 30) 3.39um

ANGLE	BTDF DATA	ANGLE	BTDF DATA
0	97999.5946945	0	97999.5946945
0.2	40.1623966509	-0.2	590.303559108
0.4	5.94068783794	-0.4	45.517382871
0.6	2.17546315192	-0.6	4.09991132478
0.8	1.17140323565	-0.8	1.17140323565
1	0.635904613639	-1	0.560600119218
1.2	0.292850908913	-1.2	0.343053804726
1.4	0.175710485348	-1.4	0.133874655503
1.6	0.108773157596	-1.6	0.0736310605266
1.8	0.06619170281701	-1.8	0.046856129426
2	0.046856129426	-2	0.0301217974881
2.2	0.0404134116299	-2.2	0.0230933780742
2.4	0.0250178262471	-2.4	0.0159729198347
2.6	0.0173200335557	-2.6	0.0115466890371
2.8	0.0140484716618	-2.8	0.00346757196056
3	0.0103920201334	-3	0.00673556860499
3.5	0.00577334451856	-3.5	0.00442623079756
4	0.00346400671114	-4	0.00288667225928
5	0.00144333612964	-5	0.00157804750174
6	0.00115466890371	-6	0.0010776909768
7	9.044906412E-4	-7	8.852461535E-4
8	6.735568605E-4	-8	6.735568605E-4
9	5.773344519E-4	-9	5.580899701E-4
10	4.618675615E-4	-10	4.618675615E-4
12	3.271561894E-4	-12	3.079117077E-4
15	2.11689299E-4	-15	2.309337807E-4



SAMPLE - ZnSe 1/4 (0 0) 10.6um

ANGLE

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 1.2 1.4 1.6 1.8 2 2.5 3 3.5 4 4.5 5 6 7 8 9 10 11 12 13

BIDF DATA

27397.260274  
24993.669454  
19204.2587329  
521.14869563  
25.6515484981  
10.2371747523  
0.756753816082  
2.36256218723  
1.41911729046  
0.248972418423  
0.515120625421  
0.316401395854  
0.48617155088  
0.656808150813  
0.113197093891  
0.0030428612567  
0.0020371919461  
0.154678011E-4  
0.001360959828  
4.367998550E-4  
3.053943282E-4  
4.683034146E-4  
3.481992781E-4  
2.188249859E-4  
2.018731148E-4  
1.363910772E-4  
1.853867508E-4  
1.891836037E-4  
1.617502333E-4  
1.248029551E-4

ANGLE

14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 32 33 34 35 36 37 38 38 37 36 35 34 33 32 31

BIDF DATA

1.286884356E-4  
1.1707694E-4  
1.142997587E-4  
9.886198222E-5  
9.847803999E-5  
8.534482653E-5  
7.485822911E-5  
7.333743472E-5  
6.609571281E-5  
5.832508248E-5  
5.349727691E-5  
4.679914367E-5  
4.412821925E-5  
4.198469858E-5  
3.905965299E-5  
4.162518111E-5  
4.055642668E-5  
2.970392708E-5  
2.738897667E-5  
2.550836298E-5  
2.419948588E-5  
1.425971961E-5  
4.906412061E-6  
6.024964966E-5  
3.01279985E-5  
3.653363949E-5  
3.090968317E-5  
2.561747698E-5  
3.620191703E-5  
3.590431605E-5  
3.639619327E-5  
4.042498915E-5

ZnSe 1/4 0 0 10.6  $\mu$ m

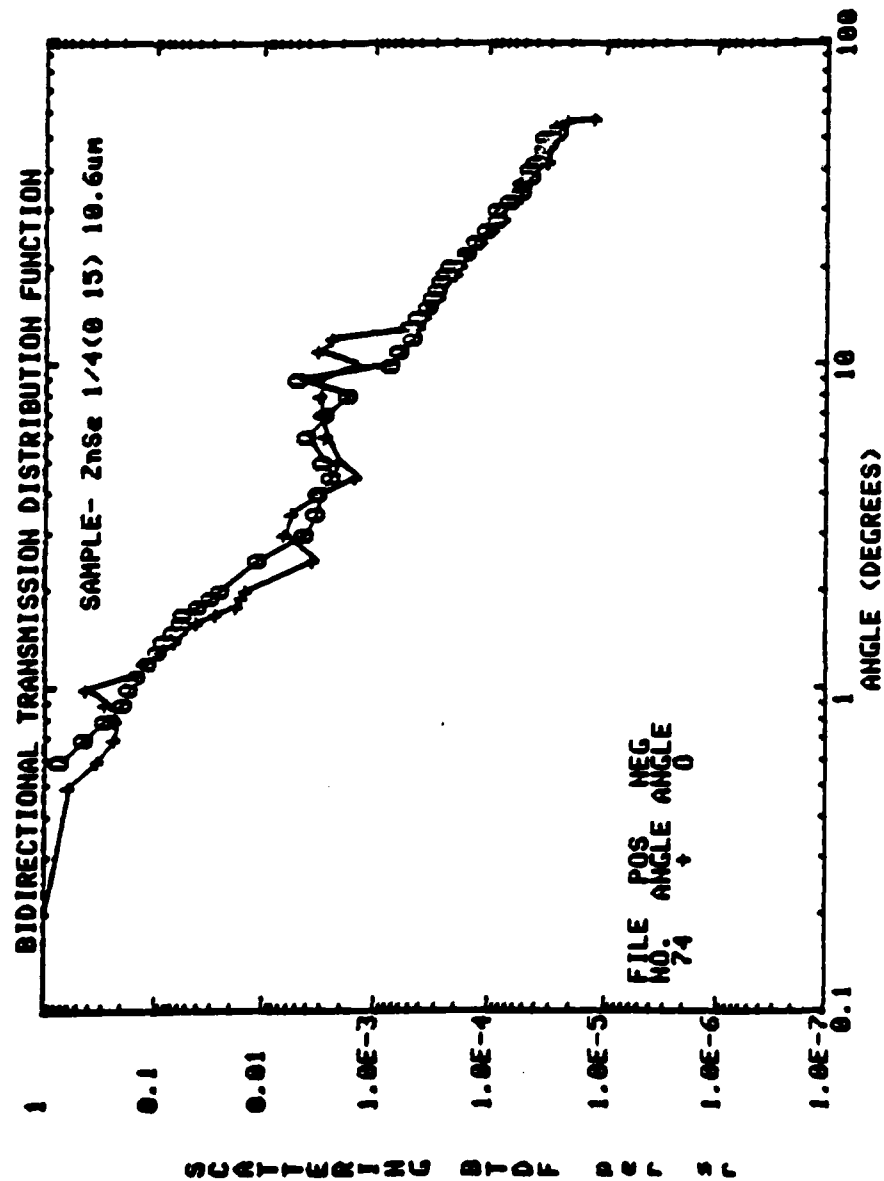
ANGLE  
-1.6  
-1.4  
-1.2  
-1.0  
-0.8  
-0.7  
-0.6  
-0.5  
-0.4  
-0.3  
-0.2  
-0.1  
0

BTDF DATA  
0.00682351559574  
0.168111973675  
0.11147460165  
0.22053107561  
0.113696478363  
0.07497816197  
0.0577174459989  
0.136131291346  
0.203590033593  
0.165982658061  
0.3527851526  
9.25412975126  
2205.58610331  
24340.6941745

ANGLE  
-30  
-29  
-28  
-27  
-26  
-25  
-24  
-23  
-22  
-21  
-20  
-19  
-18  
-17  
-16  
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-5  
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-1.8

BTDF DATA  
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1.923131929E-4  
2.014769813E-4  
2.239774512E-4  
2.039418067E-4  
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0.00296653210818





SAMPLE - ZnSe 1/4(0 15) 10.6um

ANGLE  
0  
0.1  
0.2  
0.3  
0.4  
0.5  
0.6  
0.7  
0.8  
0.9  
1  
1.1  
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BTDF DATA  
166680.539207  
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0.415009238294  
0.150978757757  
0.124293477703  
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0.0624717838966  
0.0543377680949  
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0.0029491775060  
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0.0020612539563  
0.0026637757030  
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0.0029967515589

ANGLE  
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10  
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54  
56  
57  
-54

BTDF DATA  
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2.710578003E-4  
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1.931425066E-4  
1.750035057E-4  
1.556279879E-4  
1.154331725E-4  
9.172857159E-5  
7.297095968E-5  
7.750629522E-5  
5.62748413E-5  
5.565677732E-5  
4.885459965E-5  
4.741196237E-5  
4.102195132E-5  
3.030287804E-5  
3.318913129E-5  
3.545700781E-5  
3.112822607E-5  
2.494403714E-5  
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2.587220733E-5  
2.061551509E-5  
1.210137081E-5  
2.35014473E-5

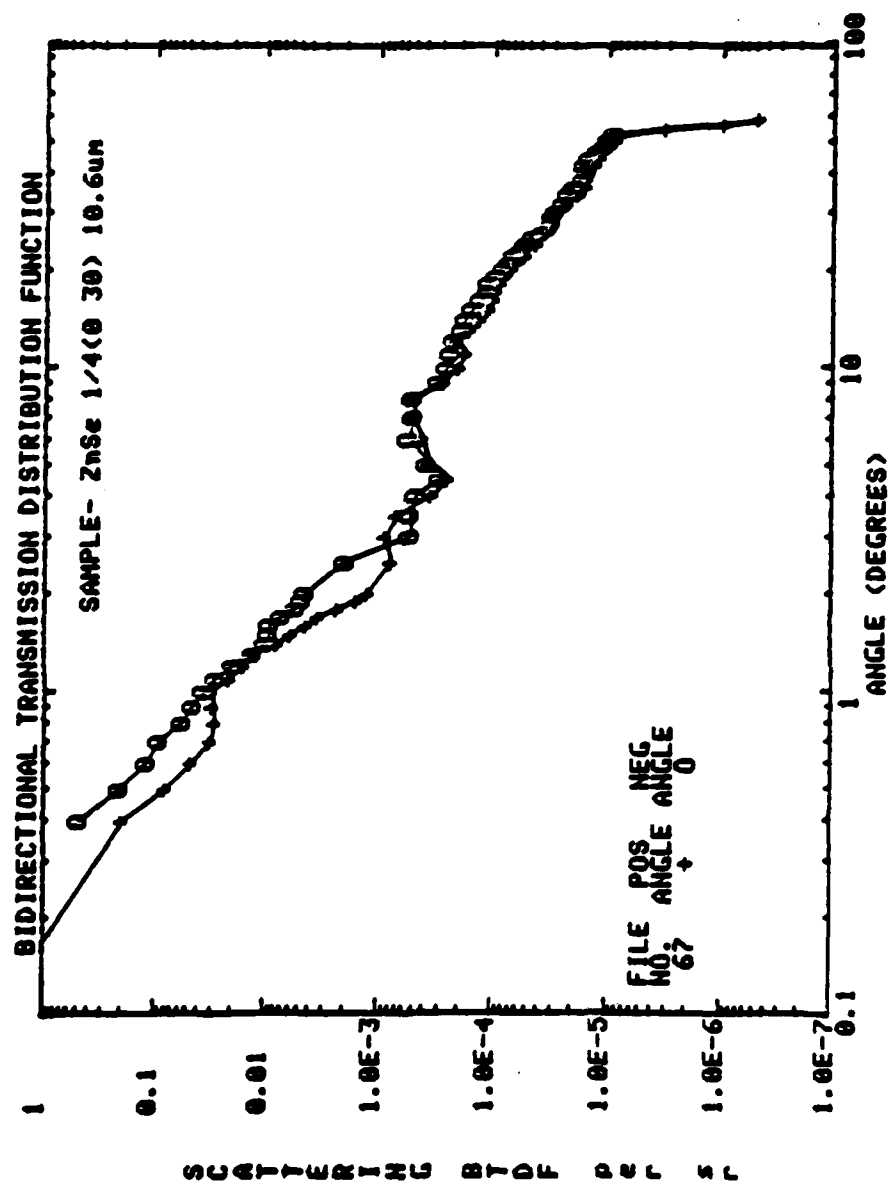
SAMPLE - ZnSe 1/4 (0 15) 10.6  $\mu$ m

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-36  
-34  
-32  
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-28  
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-6  
-5  
-4.5

BTDF DATA  
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4.246462716E-5  
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8.286532709E-5  
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0.00239422522164

ANGLE  
-4  
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-3.5  
-2.5  
-2  
-1.9  
-1.8  
-1.7  
-1.6  
-1.5  
-1.4  
-1.3  
-1.2  
-1.1  
-1  
-0.9  
-0.8  
-0.7  
-0.6  
-0.5  
-0.4  
-0.3  
-0.2  
-0.1  
0

BTDF DATA  
0.00310773543649  
0.00325043700035  
0.00412250485239  
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0.0293332002681  
0.0386801121218  
0.0532595764373  
0.0560819050237  
0.0655319508423  
0.0805315204088  
0.0902511140824  
0.114066498099  
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0.190364517118  
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1.16224463657  
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164737.508347



SAMPLE - ZnSe 1/4(0 30) 10.6um

ANGLE  
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BTDF DATA  
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2499.17803358  
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0.045303917066  
0.029980646091  
0.027921725224  
0.028664161675  
0.029773989292  
0.020214166191  
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0.012557189537  
0.007396741806  
0.005617024638  
0.004132152138  
0.003239298504  
0.002184712864  
0.001510829636  
0.001240610791  
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3.415674961E-4  
2.466913823E-4  
3.61834074E-4  
4.148132102E-4  
5.054381514E-4  
4.846981352E-4

ANGLE  
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BTDF DATA  
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1.078943113E-4  
9.980111695E-5  
9.488202310E-5  
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8.127532988E-5  
6.875539310E-5  
6.41466689E-5  
5.315869401E-5  
5.535668308E-5  
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2.935309935E-5  
2.707812174E-5  
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1.799580839E-5  
1.57903811E-5  
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1.478772469E-5  
1.281747458E-5  
1.163130286E-5  
1.212336636E-5  
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7.794527994E-6

# ANGLE

54  
56  
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## BTDF DATA

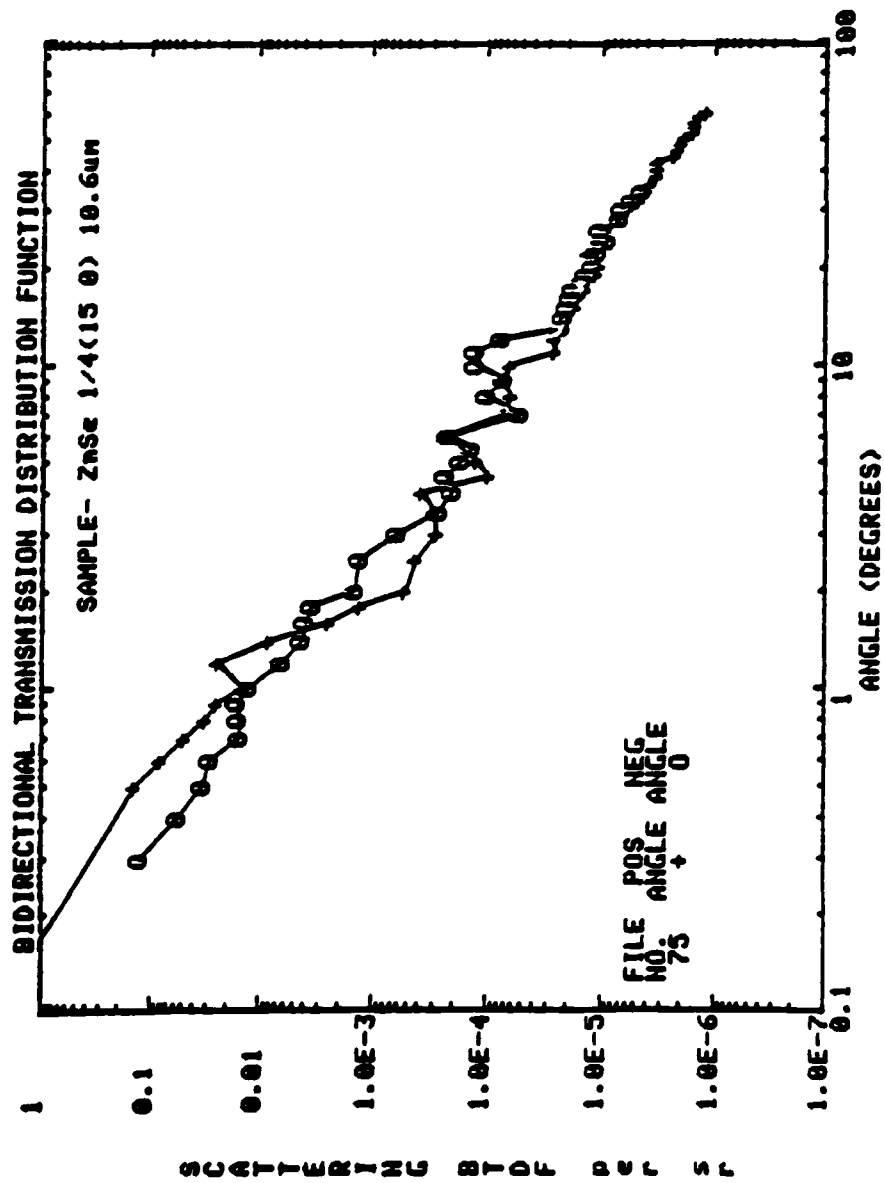
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2.934053346E-5  
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# ANGLE

-13  
-12  
-11  
-10  
-9  
-8  
-7  
-6  
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-2  
-1  
0  
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## BTDF DATA

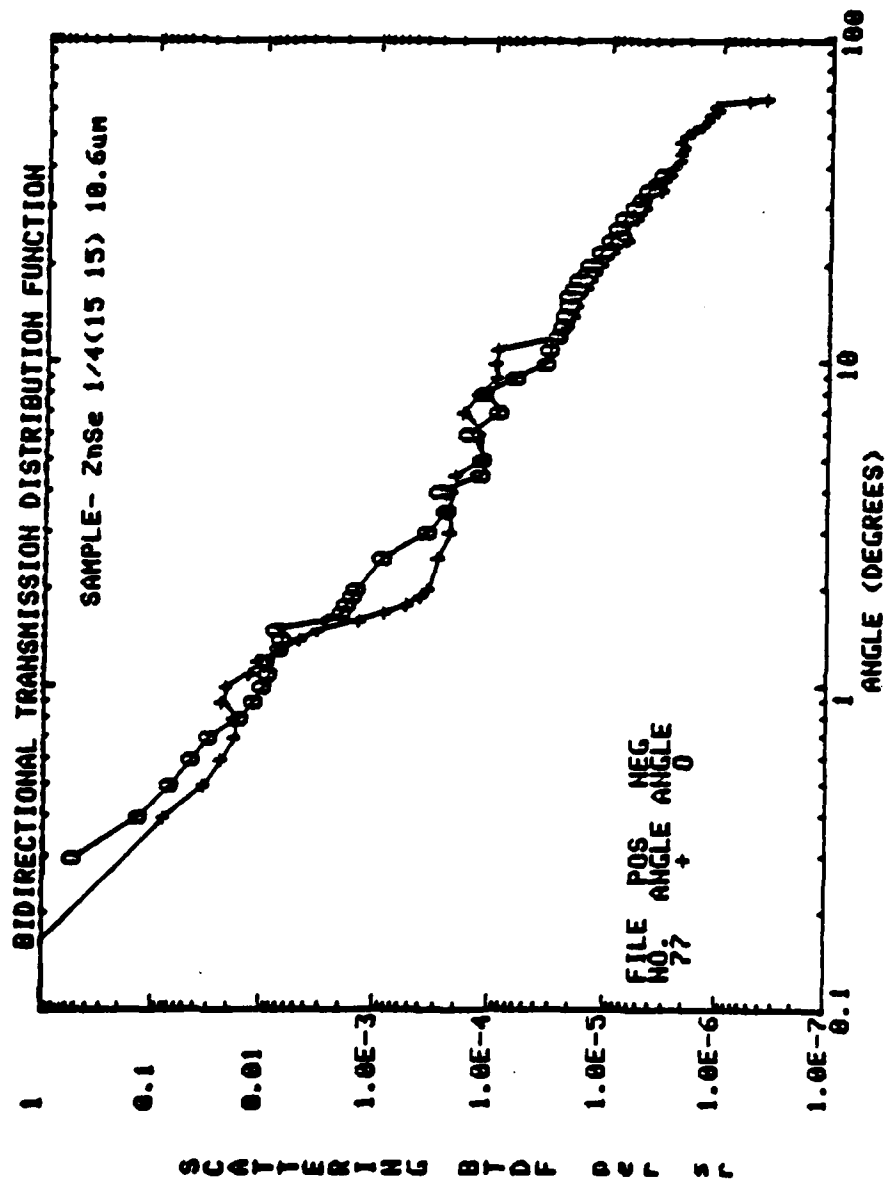
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0.116769143227  
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2207.65318689



SAMPLE - ZnS: 1/4(15 0) 10.6um

ANGLE	BTDF DATA	ANGLE	BTDF DATA	ANGLE	BTDF DATA
0	16360.7221395	14	2.036535066E-5	-26	1.043026005E-5
0.1	13664.2332457	15	1.712917932E-5	-24	9.028523134E-6
0.2	7690.72621681	16	1.632530633E-5	-22	1.104855649E-5
0.3	2444.54288988	17	1.401669855E-5	-20	1.214099704E-5
0.4	4.58406495787	18	1.402062154E-5	-19	1.30106168E-5
0.5	0.137120798039	19	1.053319098E-5	-18	1.500613697E-5
0.6	0.076729298017	20	1.053319098E-5	-17	1.776822674E-5
0.7	0.046788826022	22	1.306862839E-5	-16	1.884086308E-5
0.8	0.0297945994741	24	1.069818152E-5	-15	2.007679983E-5
0.9	0.023704393894	26	9.255309808E-6	-14	2.166395096E-5
1	0.014076763267	28	7.64752140E-6	-13	2.271517036E-5
1.2	0.023230306695	30	5.771745388E-6	-12	7.483978761E-5
1.4	0.087927891357	32	4.699876856E-6	-11	1.258956101E-4
1.6	0.002389466521	34	4.040269761E-6	-10	1.257369289E-4
1.8	0.001257363643	36	3.751703433E-6	-9	7.166840069E-5
2	5.089706733E-4	38	3.195153986E-6	-8	1.005259518E-4
2.5	4.122504326E-4	40	3.215791150E-6	-7	5.200700081E-5
3	2.743051306E-4	42	3.133358817E-6	-6	2.18810147E-4
3.5	2.917465412E-4	44	2.205737297E-6	-5	1.373112505E-4
4	3.662688193E-4	46	2.102683022E-6	-5	1.696378564E-4
4.5	9.830593625E-5	48	1.968705688E-6	-4	2.314946241E-4
5	1.214554254E-4	50	1.842972661E-6	-4	2.013685716E-4
6	2.314947932E-4	52	1.525517537E-6	-3	2.663772768E-4
7	7.341243419E-5	54	1.486363465E-6	-3	6.0251994E-4
8	6.152061401E-5	56	1.484317086E-6	-2	0.00129858806282
9	7.483956886E-5	58	1.368884684E-6	-2	0.00141750710887
10	6.263062661E-5	60	1.181294447E-6	-1	0.00338520981066
11	2.531231132E-5	-35	4.12273444E-6	-1	0.00384978415034
12	2.529172568E-5	-34	4.411314943E-6	-1	0.00408444962735
13	2.2673945E-5	-32	5.42134918E-6	-1	0.00622022340897
		-30	6.761187455E-6	-1	0.012180411739
		-28	7.049736782E-6	-0.9	0.0153547391618
				-0.8	0.0150185964677





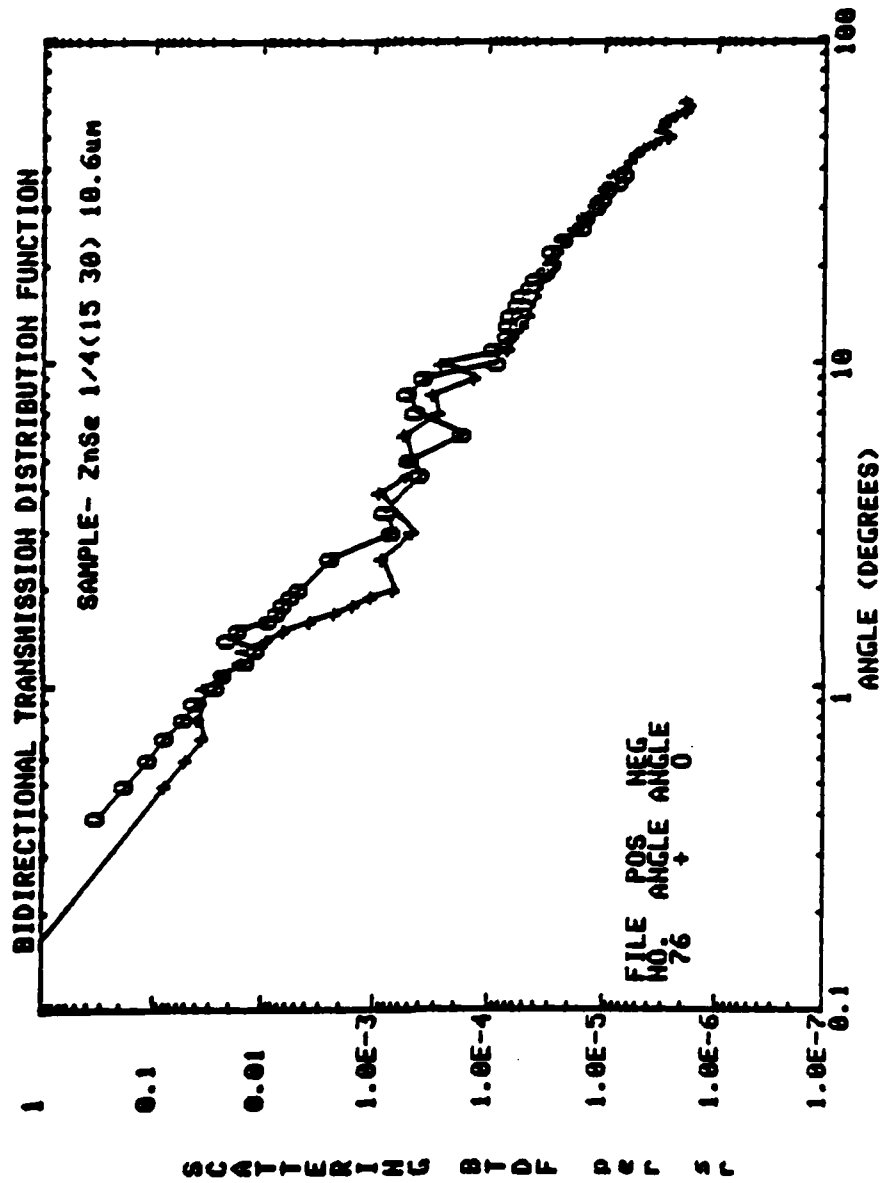
SAMPLE - ZnSe 1/4(15 15) 10.6um

ANGLE	BTDF DATA	ANGLE	UTDF DATA	ANGLE	DTDF DATA
0	1478.4831465	9	9.133139397E-5	-2.5	0.625712849E-4
0.1	10314.0155651	10	9.323421353E-5	-2	0.00144607523845
0.2	2179.38720230	11	9.047745219E-5	-1.9	0.00154121173941
0.3	3.23188243512	12	2.516053219E-5	-1.0	0.00175368328655
0.4	0.0748343802573	13	2.226211017E-5	-1.7	0.00189004560906
0.5	0.0323115307918	14	1.970612108E-5	-1.6	0.00235145771419
0.6	0.0223190258979	15	1.840752146E-5	-1.5	0.00729855677867
0.7	0.0160851455115	16	1.813957692E-5	-1.4	0.0064994099138
0.8	0.0178698085491	17	1.53900500E-5	-1.3	0.00680384669206
0.9	0.0218084604013	18	1.37902446E-5	-1.2	0.00890160682503
1	0.0199485417135	19	1.253205965E-5	-1.1	0.00834505810833
1.1	0.0122535833291	20	1.115179168E-5	-1	0.009456569651
1.2	0.0105775951425	22	9.090497776E-6	-0.9	0.011479806115
1.3	0.00641061574831	24	6.678761568E-6	-0.8	0.0155437207814
1.4	0.00439530721665	26	7.338426388E-6	-0.7	0.0292481354217
1.5	0.00306022476273	28	5.524461031E-6	-0.6	0.0416475940774
1.6	0.00135569544547	30	4.720553675E-6	-0.5	0.0669935463483
1.7	0.197597147E-4	32	4.720580834E-6	-0.4	0.130340192514
1.8	5.280077165E-4	34	3.401312698E-6	-0.3	0.51858912466
1.9	3.948165876E-4	36	3.751775346E-6	-0.2	351.721585251
2	3.456627215E-4	38	2.906615145E-6	-0.1	8885.59793082
2.5	2.885808343E-4	40	2.741720656E-6	0	13464.9368109
3	2.235708947E-4	42	2.350064159E-6		
3.5	2.362558037E-4	44	2.308853389E-6		
4	2.203997479E-4	46	2.185183064E-6		
4.5	1.997868612E-4	48	2.329507927E-6		
5	1.227262418E-4	50	2.102760791E-6		
5.5	1.284345046E-4	52	1.814163737E-6		
6	1.760029458E-4	54	1.443098986E-6		
7	1.30178846E-4	56	1.331787802E-6		
8		58	1.276138345E-6		
		60	1.07823532E-6		
		62	1.142158949E-6		

ZnSe 1/4 (15 15) 10.6  $\mu$ m

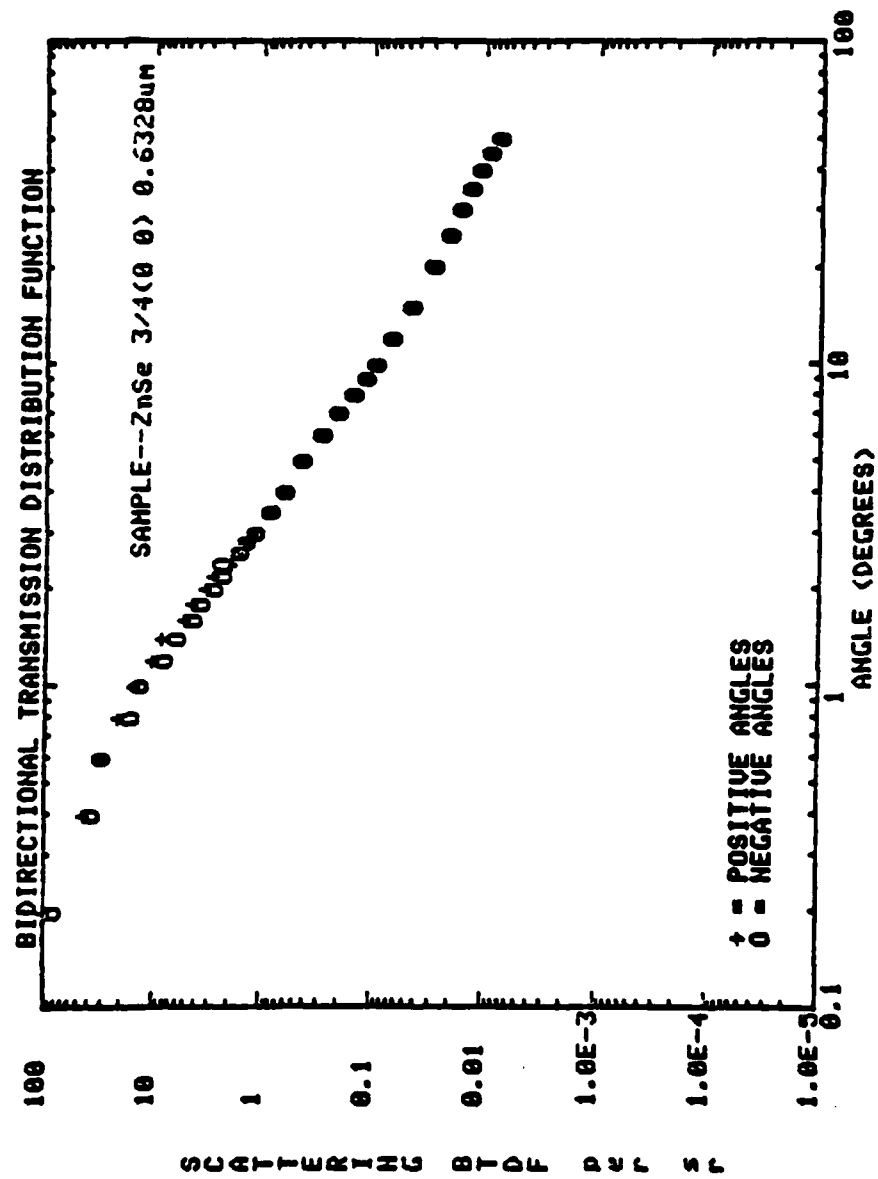
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-1.3  
-1.2  
-1.1  
-1  
-0.9  
-0.8  
-0.7  
-0.6  
-0.5  
-0.4  
-0.3  
-0.2  
-0.1  
0

BTDF DATA  
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SAMPLE - ZnSe 1/4(15 30) 10.6um

ANGLE	BTDF DATA	ANGLE	BTDF DATA	ANGLE	BTDF DATA	UTDF DATA
0	20159.0039814	9	1.29364217E-4	64	1.005539167E-6	
0.1	16275.1361047	10	2.53067932E-4	-40	5.584532356E-6	
0.2	3132.06073566	11	6.550128654E-5	-38	6.407014002E-6	
0.3	1.70250662069	12	5.07202047E-5	-36	7.294421933E-6	
0.4	2.26081051579	13	4.085059187E-5	-34	9.025976018E-6	
0.5	0.076356235422	14	4.419717924E-5	-32	9.935007162E-6	
0.6	0.0491602080151	15	4.248735533E-5	-30	1.116070196E-5	
0.7	0.0340807674435	16	3.766077667E-5	-28	1.38742237E-5	
0.8	0.0376803094357	17	3.75742577E-5	-26	1.499967038E-5	
0.9	0.034770041908	18	3.294246146E-5	-24	2.179595699E-5	
1	0.0344254052322	19	3.155720729E-5	-22	2.69905008E-5	
1.1	0.0212526141157	20	2.66440953E-5	-20	2.722849057E-5	
1.2	0.0153554925249	22	2.430660896E-5	-19	3.064022963E-5	
1.3	0.0143598747223	24	2.233706814E-5	-18	3.831022127E-5	
1.4	0.0084641785538	26	1.738057068E-5	-17	4.205459834E-5	
1.5	0.00600201156161	28	1.337639664E-5	-16	5.025765714E-5	
1.6	0.00354792977021	30	1.125528105E-5	-15	5.43916067E-5	
1.7	0.00207614664061	32	1.116876622E-5	-14	6.210339665E-5	
1.8	0.00142683055321	34	9.805197838E-6	-13	6.491046744E-5	
1.9	9.989478958E-4	36	8.78793859E-6	-12	6.731287749E-5	
2	6.443214044E-4	38	8.030412821E-6	-11	8.776637522E-5	
2.5	8.224672016E-4	40	6.32047848E-6	-10	8.309119265E-5	
3	4.412020976E-4	42	5.671157406E-6	-9	3.596225337E-4	
3.5	6.54311134E-4	44	5.130057373E-6	-8	4.978104295E-4	
4	8.524360277E-4	46	4.437428459E-6	-7	4.295484998E-4	
4.5	4.944795902E-4	48	3.463309008E-6	-6	1.653261252E-4	
5	4.661761473E-4	50	2.619211757E-6	-5	4.811603806E-4	
5.5	5.27782647E-4	52	3.073814794E-6	-4.5	3.879250657E-4	
6	2.697164999E-4	54	2.900670662E-6	-3.5	7.941630955E-4	
7	2.996852004E-4	56	2.792465188E-6	-3	6.759549118E-4	
8		58	2.294600073E-6	-2.5	0.00229258570156	
		60	1.84869505E-6	-2	0.00444698312973	
		62	1.78593757E-6			



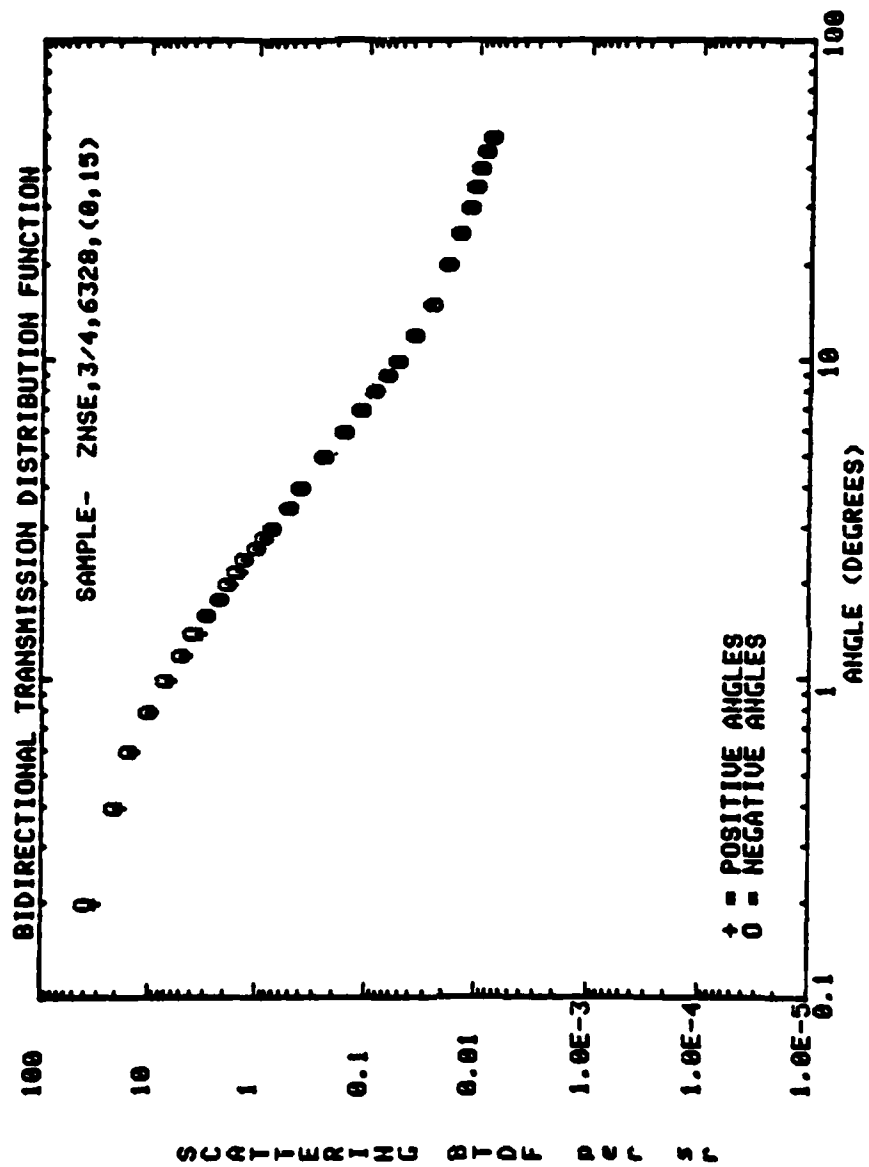
SAMPLE--ZnSe 3/4(0 0) 0.6320um

ANGLE  
0 0.2  
0.4  
0.6  
0.8  
1  
1.2  
1.4  
1.6  
1.8  
2  
2.2  
2.4  
2.6  
2.8  
3  
3.5  
4  
5  
6  
7  
8  
9  
10  
12  
15  
20  
25  
30  
35  
40  
45  
50

BTDF DATA  
166666.666667  
93.2800306319  
42.4424141738  
28.2949430451  
20.3661405882  
14.6138721166  
9.94987058036  
8.88427004158  
4.98128112975  
4.18808362975  
3.17279074048  
2.69687223451  
1.84021877974  
1.61001383068  
1.35263073505  
1.17739118901  
0.805007120385  
0.591433505632  
0.40493140025  
0.271286702244  
0.194936670087  
0.146202604313  
0.114525463708  
0.0509706612945  
0.0666182507749  
0.044646699675  
0.0204756855133  
0.0203902090914  
0.0162596420699  
0.0130430663158  
0.0107229230279  
0.00891250685397  
0.00747120097781

ANGLE  
0  
-0.2  
-0.4  
-0.6  
-0.8  
-1  
-1.2  
-1.4  
-1.6  
-1.8  
-2  
-2.2  
-2.4  
-2.6  
-2.8  
-3  
-3.5  
-4  
-5  
-6  
-7  
-8  
-9  
-10  
-12  
-15  
-20  
-25  
-30  
-35  
-40  
-45  
-50

BTDF DATA  
166666.666667  
78.0515655921  
35.5482379923  
29.0568208894  
15.610313553  
12.8282776885  
7.72787028335  
5.87318763704  
4.88096469533  
3.46965992718  
2.61801621919  
2.1764232068  
2.27105039968  
1.52437956678  
1.33383218777  
1.12150794068  
0.800299476406  
0.593419442894  
0.411010021447  
0.273737658899  
0.194604175766  
0.145347618323  
0.113048236749  
0.0904386691232  
0.0657044328647  
0.0440361151772  
0.028134413129  
0.0202709688979  
0.0160597052668  
0.0128519383161  
0.0106077885245  
0.00877300638912  
0.00733517428941





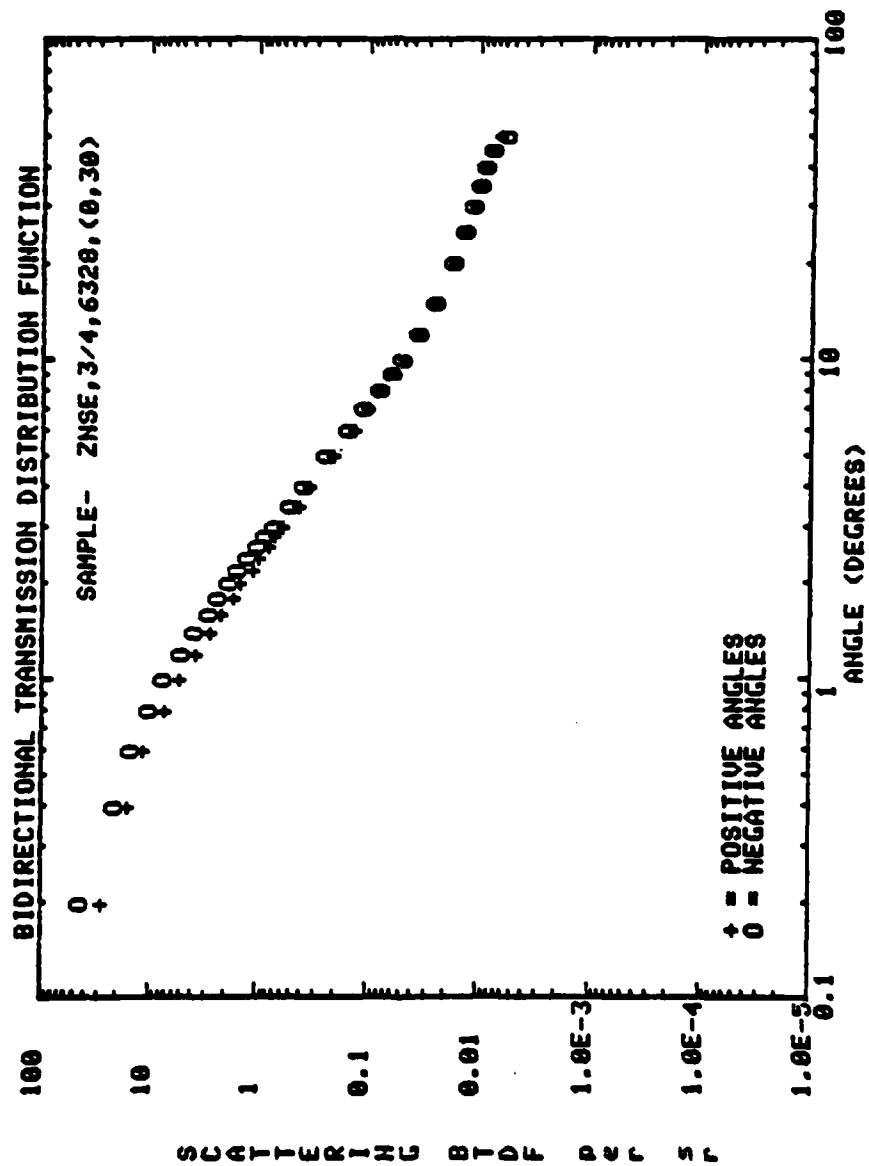
SAMPLE--ZnSe 3/4(0 15) 0.6328um

ANGLE  
0  
0.2  
0.4  
0.6  
0.8  
1  
1.2  
1.4  
1.6  
1.8  
2  
2.2  
2.4  
2.6  
2.8  
3  
3.5  
4  
5  
6  
7  
8  
9  
10  
12  
15  
20  
25  
30  
35  
40  
45  
50

BTDF DATA  
99279.8353909  
30.0823045826  
17.4314130238  
13.1755832105  
8.91975335128  
5.82664636087  
4.23096736086  
3.15106338668  
2.64334736471  
1.90251058608  
1.62722938292  
1.30829933357  
1.16769578531  
0.983703987138  
0.786557213403  
0.694513321553  
0.493650266871  
0.367352810421  
0.231824685902  
0.153361024327  
0.109671031219  
0.0838136919437  
0.064197721236  
0.0526065540863  
0.037448098663  
0.0267492504303  
0.0173871539517  
0.0137315367233  
0.011413709527  
0.010165186786  
0.0094520048089  
0.0085604750402  
0.0074905807476

ANGLE  
0  
-0.2  
-0.4  
-0.6  
-0.8  
-1  
-1.2  
-1.4  
-1.6  
-1.8  
-2  
-2.2  
-2.4  
-2.6  
-2.8  
-3  
-3.5  
-4  
-5  
-6  
-7  
-8  
-9  
-10  
-12  
-15  
-20  
-25  
-30  
-35  
-40  
-45  
-50

BTDF DATA  
104938.271605  
38.1858711271  
20.1714679138  
14.8662553923  
9.85253801546  
6.72925271276  
4.75480141506  
3.71519238174  
2.78840911034  
2.11951335016  
1.76611829758  
1.4574763218  
1.25342969825  
0.966461268467  
0.807476288227  
0.698697136743  
0.493690266871  
0.387860370227  
0.236282852939  
0.156035925914  
0.107887762419  
0.0820304219023  
0.064197721236  
0.0508232810664  
0.035665533206  
0.02496559670683  
0.017832978412  
0.0141773658377  
0.0115025379132  
0.010165186786  
0.00936283494434  
0.00829296019522  
0.00740140716736

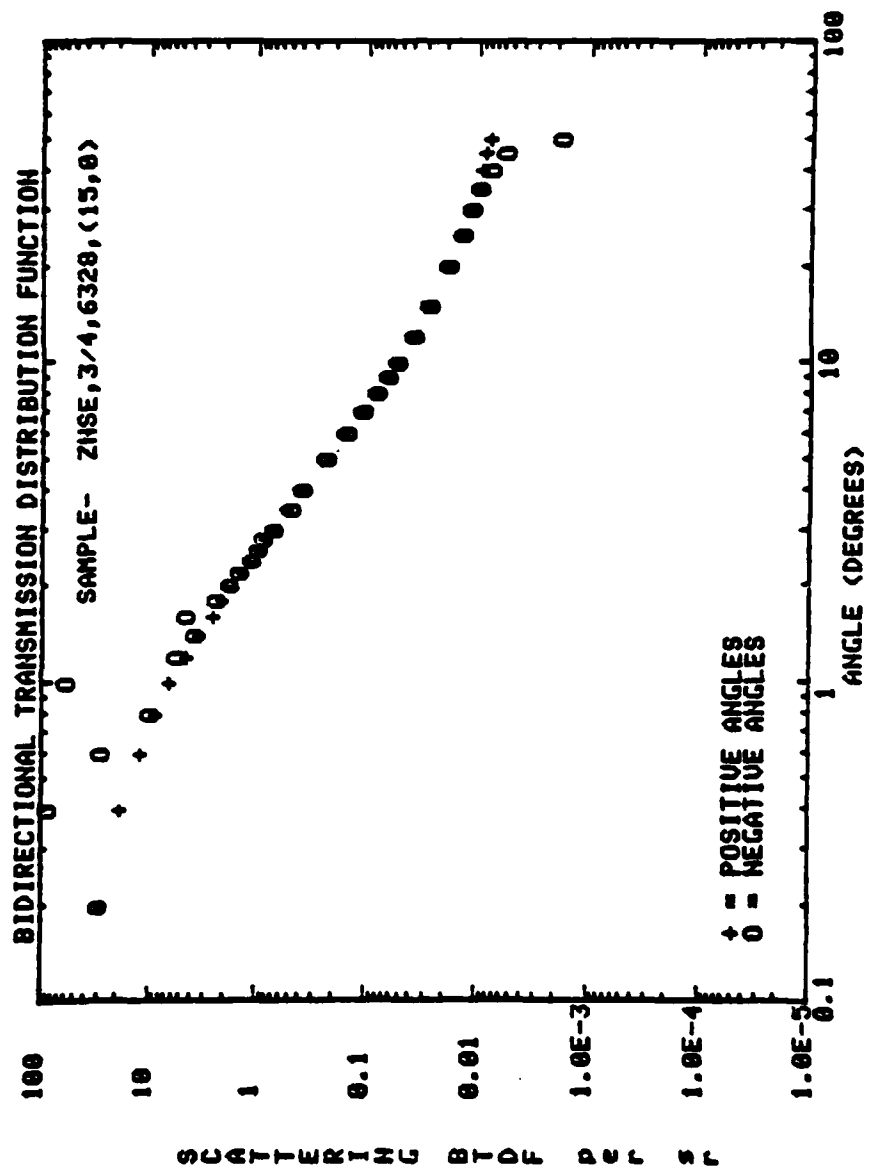


SAMPLE--ZnSe 3/4(0 30) 0.6328um

ANGLE  
0  
0.2  
0.4  
0.6  
0.8  
1  
1.2  
1.4  
1.6  
1.8  
2  
2.2  
2.4  
2.6  
2.8  
3  
3.5  
4  
5  
6  
7  
8  
9  
10  
12  
15  
20  
25  
30  
35  
40  
45  
50

BTDF DATA  
90020.5761317  
26.0596708303  
14.8662552544  
10.7270234988  
6.87928689837  
5.02074783239  
3.52983562678  
2.60305236291  
2.03892342461  
1.58762026609  
1.37680640093  
1.03566552749  
0.917352782877  
0.748902841193  
0.661042764456  
0.55644742028  
0.405830134631  
0.326337690811  
0.195267716202  
0.129286918043  
0.0971881496167  
0.0731140716955  
0.0570646863321  
0.0454734620068  
0.0329906182155  
0.0246093103959  
0.0160496805708  
0.0128398784945  
0.0107000352681  
0.00945184034489  
0.00829279666498  
0.0077579305052  
0.00633132420341

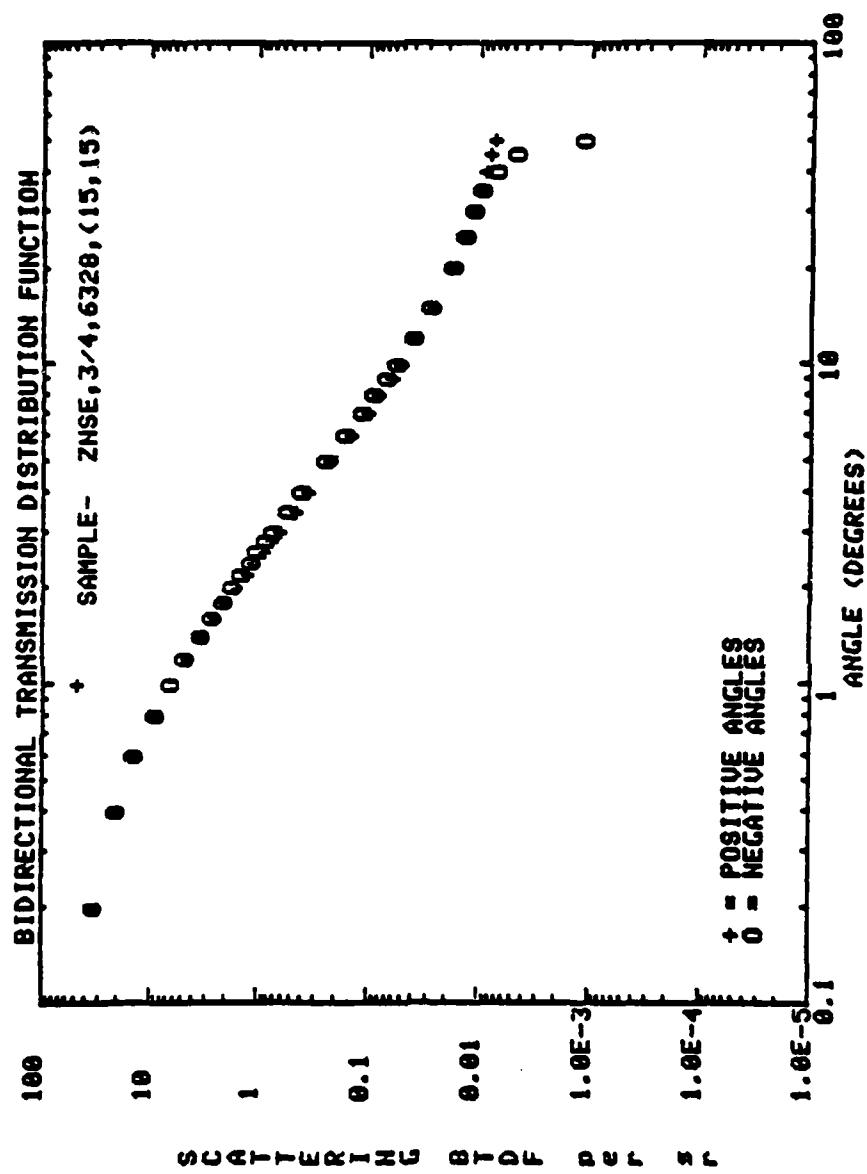
BTDF DATA  
99794.2386831  
41.8587106401  
20.3463650344  
14.224965944  
9.79423897395  
7.14831994756  
4.81927329866  
3.67489745352  
2.70781925166  
2.22428016975  
1.748971518  
1.45404696575  
1.18655724439  
0.949725949446  
0.811660103192  
0.681961875983  
0.481138819408  
0.367352810421  
0.227366518866  
0.147119587291  
0.105212859218  
0.0757889767576  
0.0588479577799  
0.0472567350267  
0.0347738948758  
0.0242526537235  
0.0166738348152  
0.0131073759631  
0.0110567031104  
0.00971934526031  
0.00856030623482  
0.00749041566019  
0.0057071091411



SAMPLE--ZnSe 3/4(15 0) 0.6328um

SAMPLE-ZNSE, 3/4, 6328, (15, 0)

ANGLE	BTDF DATA	BTDF DATA	ANGLE
0	94029.8507463	92537.3134328	0
0.2	29.6019901047	28.5306799866	-0.2
0.4	17.5356551882	81.7578778872	-0.4
0.6	11.671641986	26.7827533495	-0.6
0.8	8.34494220467	9.30348286332	-0.8
1	6.18872333854	56.3847455679	-1
1.2	4.30248784964	5.28457746749	-1.2
1.4	3.26503777623	3.58540662787	-1.4
1.6	2.41625235996	4.2713106234	-1.6
1.8	2.00315121323	2.25257081954	-1.8
2	1.61343313525	1.67570803903	-2
2.2	1.34991738439	1.3781097622	-2.2
2.4	1.09121090521	1.06759365191	-2.4
2.6	0.953565804877	0.92039829862	-2.6
2.8	0.783502374575	0.800158005514	-2.8
3	0.675788010211	0.663350194072	-3
3.5	0.514096477924	0.464345205867	-3.5
4	0.375124656577	0.368491152482	-4
5	0.229386667392	0.219038396682	-5
6	0.153499427195	0.144013507537	-6
7	0.104345179175	0.104345179175	-7
8	0.0814927792920	0.0787332354437	-8
9	0.06633833227757	0.0627796720826	-9
10	0.0521727130382	0.0514828259236	-10
12	0.0372539802371	0.0364778556489	-12
15	0.0258709168341	0.0253769168341	-15
20	0.0174198921061	0.0172474179268	-20
25	0.0143155063215	0.013206504420	-25
30	0.0111248426385	0.0103661253678	-30
35	0.00965892375205	0.00931396218948	-35
40	0.00808291479069	0.00741680264077	-40
45	0.0081931412232	0.00534710269303	-45
50	0.00758960335033	0.00172490985235	-50



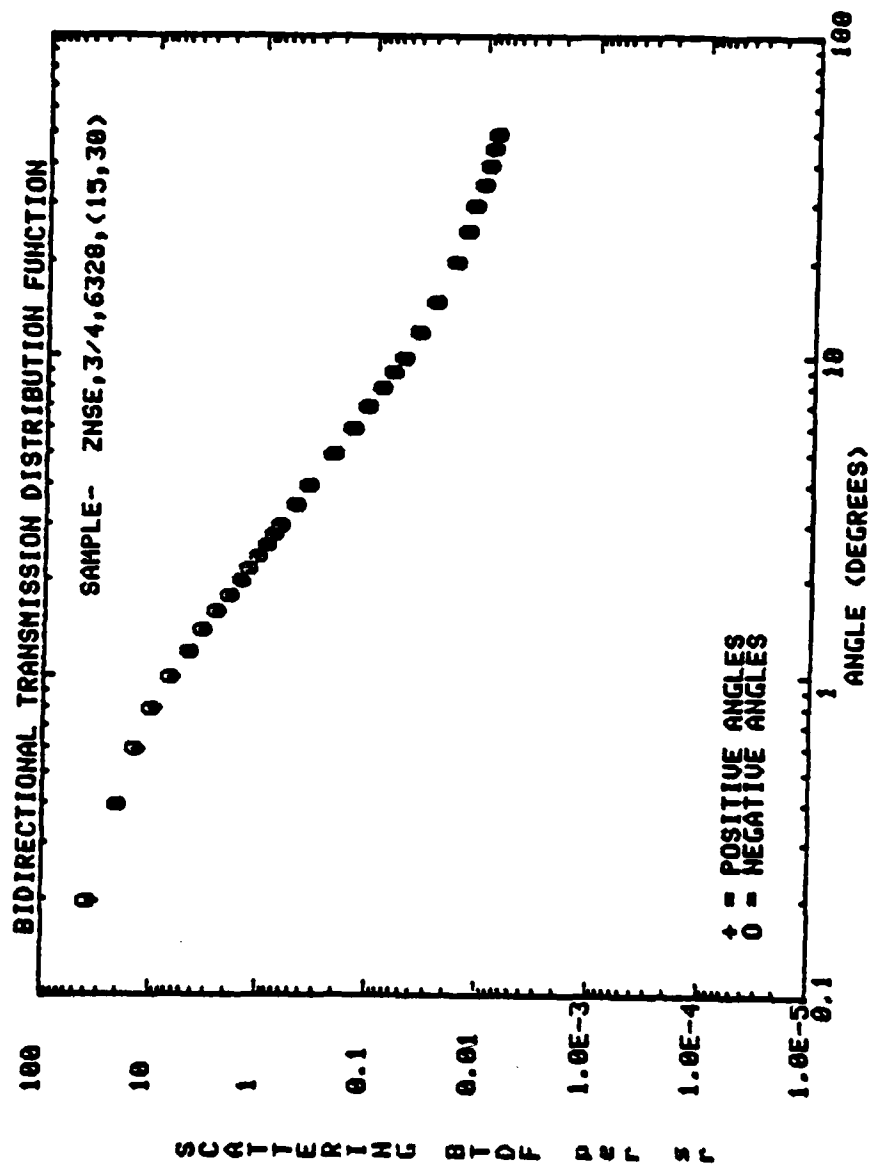
SAMPLE--2nsz 3/4(15 15) 0.6328um

ANGLE  
0 0.2 0.4 0.6 0.8 1 1.2 1.4 1.6 1.8 2 2.2 2.4 2.6 2.8 3 3.5 4 5 6 7 8 9 10 12 15 20 25 30 35 40 45 50

BTDF DATA  
98049.7512438  
32.4776120006  
20.2985076134  
12.9684910955  
9.02155914019  
46.1791066201  
4.23233859122  
3.14892234274  
2.34610309709  
1.88623577276  
1.50431205364  
1.19071336854  
1.03316777196  
0.841625471261  
0.703663694779  
0.609452996803  
0.435323630501  
0.335456302089  
0.209552481865  
0.137114656877  
0.0974463243535  
0.0773534635192  
0.0588993604841  
0.0489819851334  
0.036046675322  
0.0246636673819  
0.0162980099408  
0.013108174463  
0.010952364458  
0.00965892375205  
0.00862418911717  
0.0078401668559  
0.00715037588724

ANGLE  
0 -0.2 -0.4 -0.6 -0.8 -1 -1.2 -1.4 -1.6 -1.8 -2 -2.2 -2.4 -2.6 -2.8 -3 -3.5 -4 -5 -6 -7 -8 -9 -10 -12 -15 -20 -25 -30 -35 -40 -45 -50

BTDF DATA  
86069.6517413  
31.6882255978  
20.0729686399  
13.6451080223  
0.6268659278  
6.32902185251  
4.57529052126  
3.21907160285  
2.54096215918  
1.95535685053  
1.63681622416  
1.36152601855  
1.10613628234  
0.978441434569  
0.820895820984  
0.692371765062  
0.514096477924  
0.386922345095  
0.230249023284  
0.15522413986  
0.107794606586  
0.08520891634  
0.0666602836811  
0.0539836667139  
0.0382025769561  
0.0269919698969  
0.0170749437476  
0.0131944124529  
0.0107798862776  
0.0092272179884  
0.0089935129374  
0.00457091036663  
0.00112119140403





SAMPLE-ZNSE, 3/4, 6328, (15, 30)

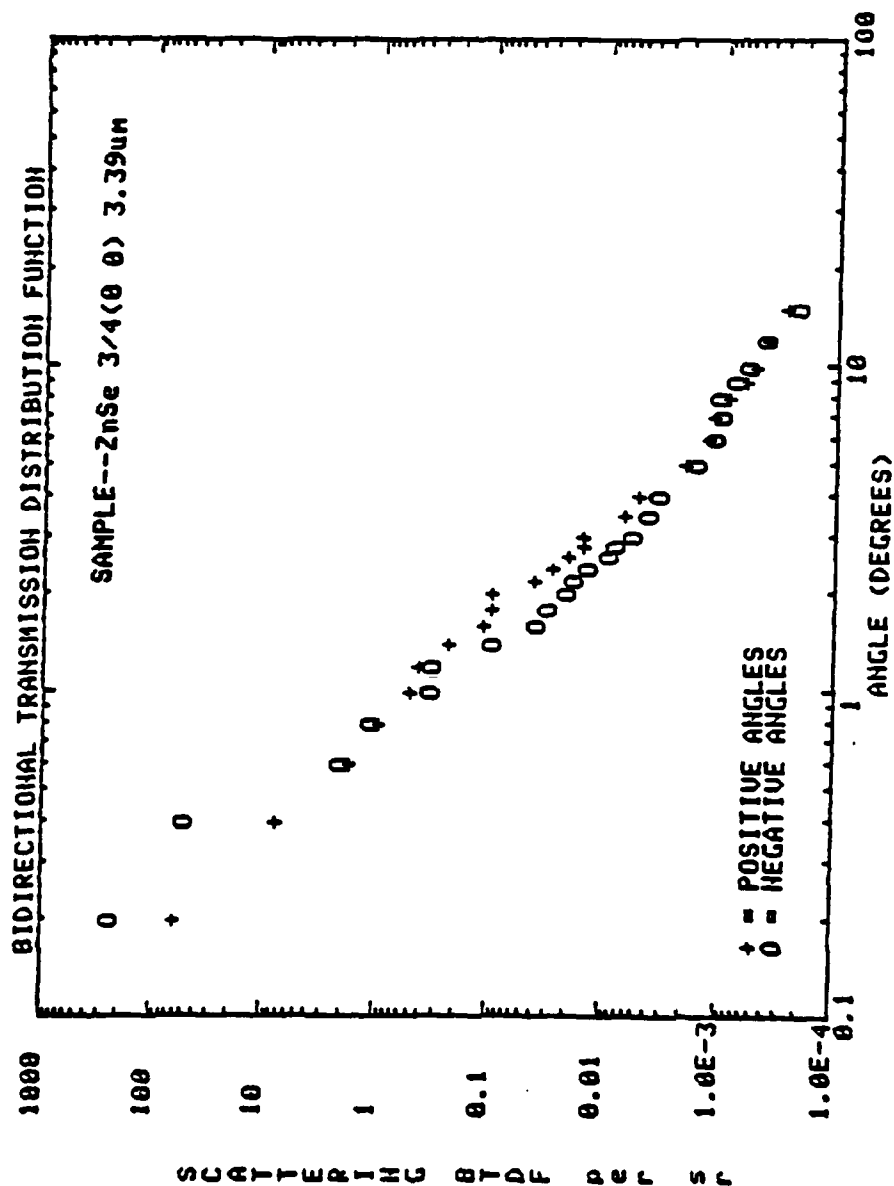
ANGLE	BTDF DATA
0	91233.4352701
0.2	31.6547740980
0.4	18.6000680959
0.6	12.4193002414
0.8	8.66462818796
1	5.78117593931
1.2	4.27200164457
1.4	3.0662591983
1.6	2.3236496134
1.8	1.72477050147
2	1.44529418599
2.2	1.2725113289
2.4	1.03465878823
2.6	0.840978057034
2.8	0.72629959377
3	0.632857892528
3.5	0.458715857041
4	0.35073080742
5	0.209378428382
6	0.14135259763
7	0.102480695093
8	0.0788925210405
9	0.0617535450198
10	0.0505337037045
12	0.0365751679061
15	0.0257087291292
20	0.0175810262399
25	0.0137822548978
30	0.0118387546177
35	0.0101602784389
40	0.00910023380697
45	0.00830523151838
50	0.00768692624566

ANGLE

0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
-2
-2.2
-2.4
-2.6
-2.8
-3
-3.5
-4
-5
-6
-7
-8
-9
-10
-12
-15
-20
-25
-30
-35
-40
-45
-50

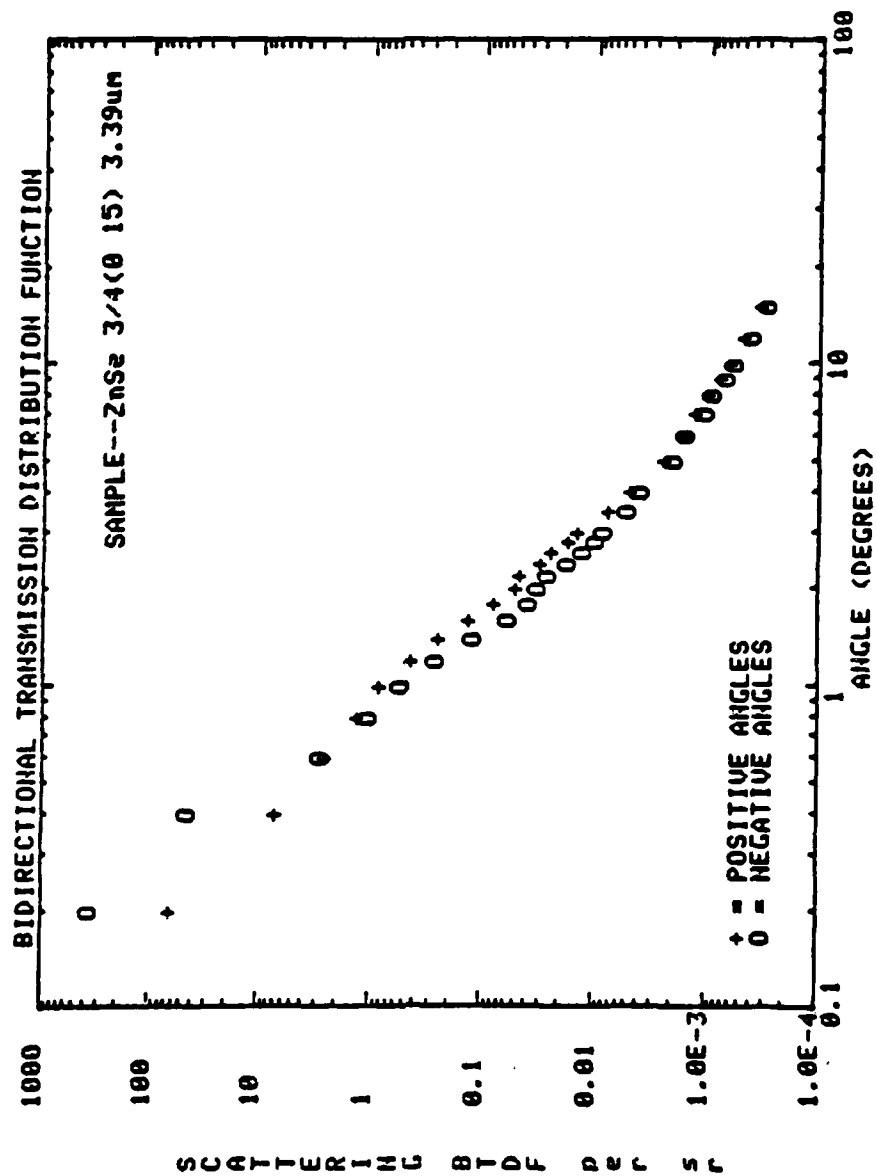
BTDF DATA

92762.4872579
36.1026164448
19.5242950821
13.632348172
9.58885519468
6.40400981122
4.31192689358
3.23394524821
2.44342536667
1.86951675946
1.43730913524
1.20965028862
0.998980098976
0.840978857034
0.72629959377
0.632857892528
0.458715857041
0.35073080742
0.209378428382
0.14135259763
0.102480695093
0.0788925210405
0.0617535450198
0.0505337037045
0.0365751679061
0.0257087291292
0.0175010262399
0.0137822548978
0.0118387546177
0.0101602784389
0.00910023380697
0.00830523151838
0.00768692624566



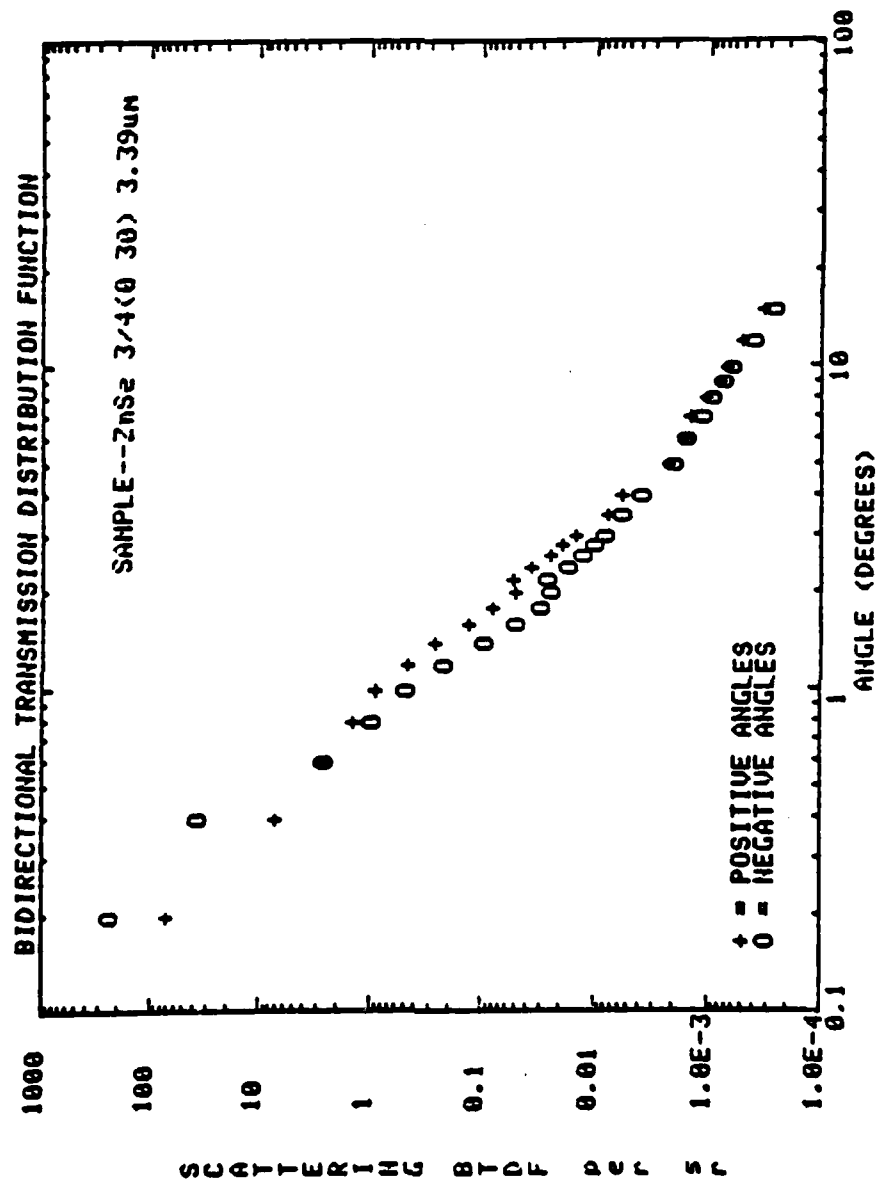
SAMPLE--ZnS<sub>2</sub> 3/4(0 0) 3.39um

ANGLE	BTDF DATA	ANGLE	BTDF DATA
0	97999.5946945	0	104254.887973
0.2	58.9048484213	-0.2	227.36936804
0.4	7.36310605266	-0.4	48.194875981
0.6	1.67343319379	-0.6	2.00811983254
0.8	0.920388256582	-0.8	1.08773157596
1	0.485295626198	-1	0.326319472788
1.2	0.409991132478	-1.2	0.317952306819
1.4	0.225913481161	-1.4	0.0920388256582
1.6	0.108773157596	-1.6	0.0368155302633
1.8	0.0920388256582	-1.8	0.0292850808913
2	0.0920388256582	-2	0.0200811983254
2.2	0.0384889634571	-2.2	0.0175710485348
2.4	0.02694227442	-2.4	0.0130362475754
2.6	0.0192444817235	-2.6	0.00866001677784
2.8	0.0142409164791	-2.8	0.00750534787413
3	0.0146258061137	-3	0.00538845488399
3.5	0.00635067897042	-3.5	0.00404134116299
4	0.00481112043213	-4	0.00327156189385
5	0.00192444817235	-5	0.00157804750174
6	0.00125089131235	-6	0.00111617594026
7	0.00111617994026	-7	9.622240864E-4
8	8.275127143E-4	-8	0.00100071304988
9	5.565789336E-4	-9	7.312903057E-4
10	5.063565249E-4	-10	5.773344519E-4
12	3.848896346E-4	-12	4.041341163E-4
15	2.694227442E-4	-15	2.11689299E-4



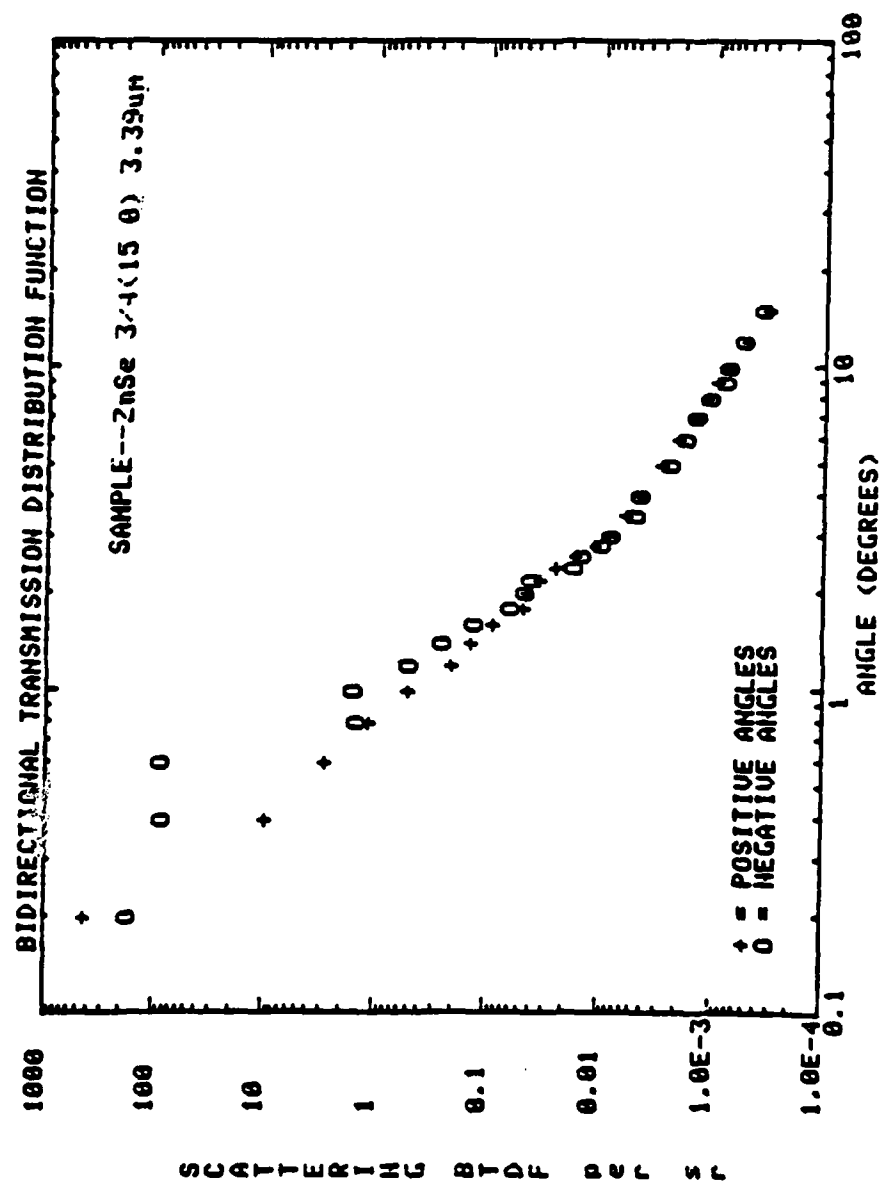
SAMPLE--ZnSe 3/4(0 15) 3.39um

ANGLE	BTDF DATA	ANGLE	BTDF DATA
0	102169.790213	0	102169.790213
0.2	61.5823415313	-0.2	346.467608441
0.4	6.69373277514	-0.4	42.8398897609
0.6	2.42647813099	-0.6	2.67749311006
0.8	1.25507489534	-0.8	1.00405991627
1	0.794860767048	-1	0.518764290074
1.2	0.418358298446	-1.2	0.251014979068
1.4	0.23428064713	-1.4	0.117140323565
1.6	0.125507489534	-1.6	0.0568967285887
1.8	0.075304937204	-1.8	0.0368155302633
2	0.0485295626198	-2	0.030958514085
2.2	0.0442623079756	-2.2	0.0250178262471
2.4	0.0288667225928	-2.4	0.0169351439211
2.6	0.0230933780742	-2.6	0.0123164683063
2.8	0.0165502542865	-2.8	0.00942979604698
3	0.01347113721	-3	0.00803268232599
3.5	0.00731290305684	-3.5	0.00500355524942
4	0.00461867561485	-4	0.00384889634571
5	0.00230933780742	-5	0.00192444817285
6	0.00153955853828	-6	0.00152031405655
7	0.00123164683063	-7	0.00101995753161
8	9.622240864E-4	-8	8.852461595E-4
9	7.505347874E-4	-9	6.735568605E-4
10	6.158234153E-4	-10	5.773344519E-4
12	4.618675615E-4	-12	4.041341163E-4
15	3.271561894E-4	-15	2.886672259E-4



SAMPLE--ZnSe 3/4(0 30) 3.39uH

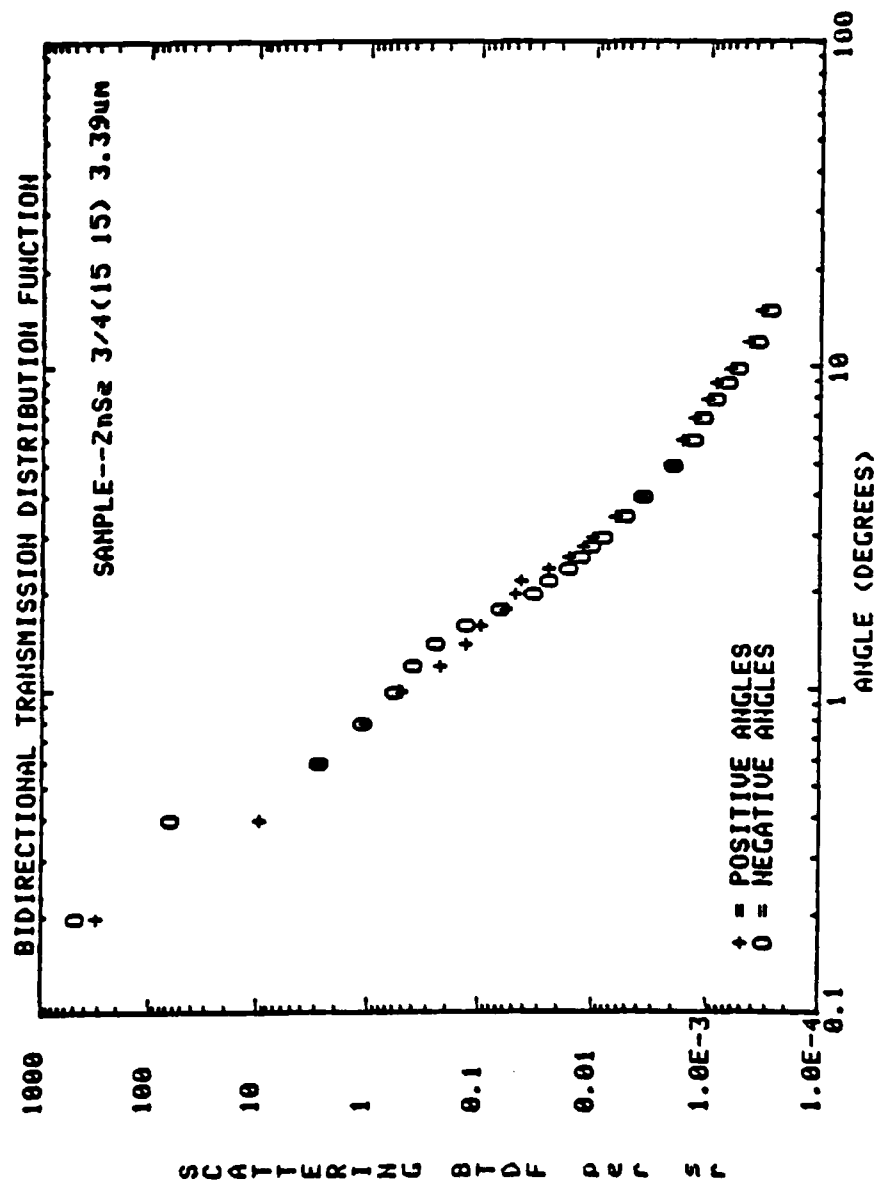
ANGLE	BTDF DATA	ANGLE	BTDF DATA
0	102169.790213	0	102169.790213
0.2	66.9373277514	-0.2	227.36936804
0.4	6.77740443483	-0.4	34.8074104307
0.6	2.3428064713	-0.6	2.51014979068
0.8	1.33874655503	-0.8	0.920388256582
1	0.836716596893	-1	0.451826962322
1.2	0.443459796353	-1.2	0.217546315192
1.4	0.251014979068	-1.4	0.0920388256582
1.6	0.125507489534	-1.6	0.0485295626198
1.8	0.0769779269141	-1.8	0.0284493642944
2	0.0485295626198	-2	0.023428064713
2.2	0.0346400671114	-2.2	0.0250178262471
2.4	0.0230933780742	-2.4	0.0165502542865
2.6	0.0182822576421	-2.6	0.0119315786717
2.8	0.0138560268445	-2.8	0.00942579604698
3	0.00731290305684	-3	0.00769779269141
3.5	0.00532845488399	-3.5	0.00538845488399
4	0.00211689299014	-4	0.00365645152842
5	0.00153955853828	-5	0.00192444817285
6	0.001347113721	-6	0.00150106957483
7	0.00100071304988	-7	0.0010776909768
8	7.697792691E-4	-8	8.852461595E-4
9	6.543123788E-4	-9	7.12045824E-4
10	4.811120432E-4	-10	5.965789336E-4
12	3.079117077E-4	-12	3.648896346E-4
15		-15	2.501782625E-4





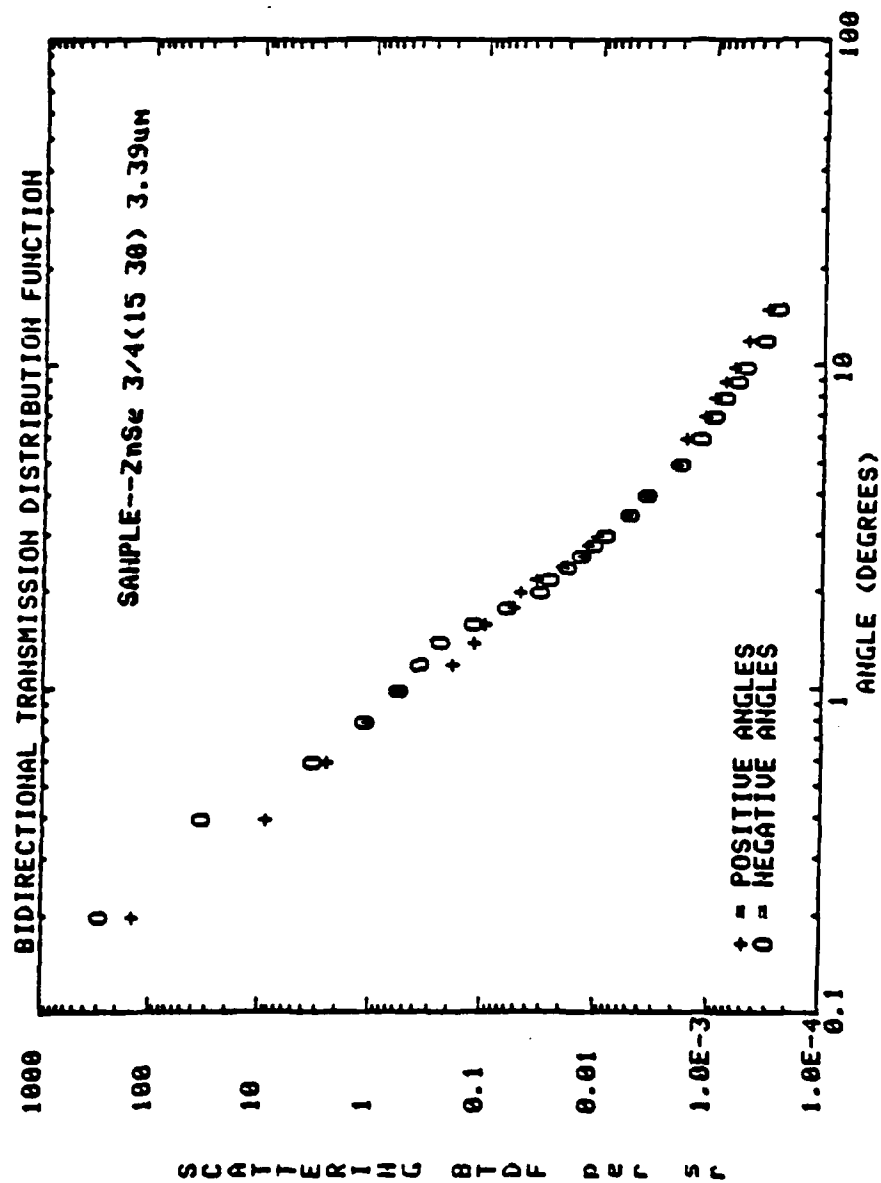
# SAMPLE--ZnSe 3/4(15 0) 3.39um

ANGLE	BTDF DATA	ANGLE	BTDF DATA
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0.2	411.430265024	-0.2	162.406691457
0.4	9.20388256582	-0.4	80.3247933017
0.6	2.67749311006	-0.6	83.0022864118
0.8	1.08773157596	-0.8	1.42241821472
1	0.405295626198	-1	1.50608987441
1.2	0.200811983254	-1.2	0.485295626198
1.4	0.133874655503	-1.4	0.242647813099
1.6	0.0836716596893	-1.6	0.125507489534
1.8	0.0451826962322	-1.8	0.0585701617825
2	0.0418358298446	-2	0.0435092630384
2.2	0.0327156189385	-2.2	0.0384889634571
2.4	0.0230933780742	-2.4	0.0165502542865
2.6	0.0157804750174	-2.6	0.0136635820273
2.8	0.0103920201334	-2.8	0.0092373512297
3	0.0078902375087	-3	0.00769779269141
3.5	0.00558089970128	-3.5	0.00461867561485
4	0.00423378590028	-4	0.00423378598028
5	0.002694227442	-5	0.00230933780742
6	0.00192444817285	-6	0.00167426991038
7	0.00130862475754	-7	0.001347113721
8	0.00111617994026	-8	0.00103920201334
9	9.044906412E-4	-9	7.697792691E-4
10	7.12045824E-4	-10	7.12045824E-4
12	4.811120432E-4	-12	5.196010067E-4
15	3.079117077E-4	-15	3.464006711E-4



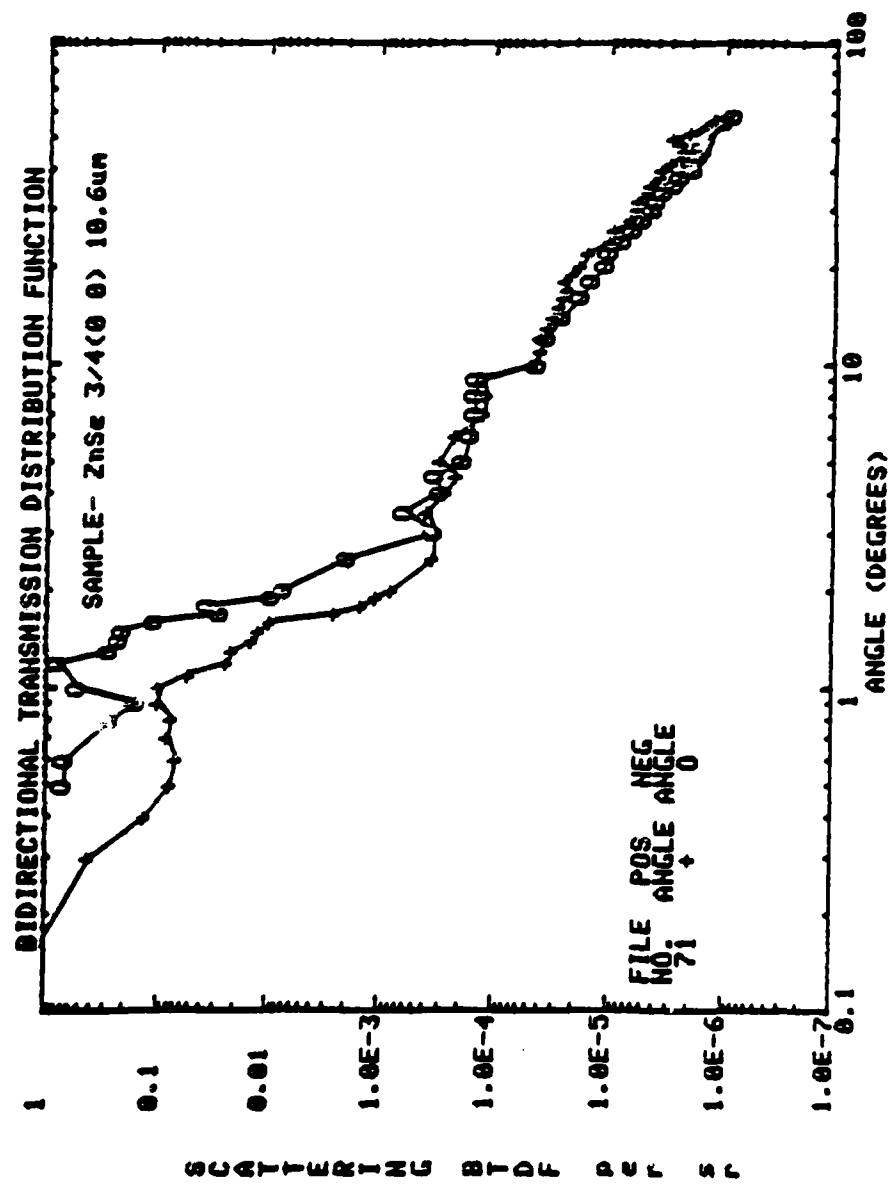
SAMPLE--ZnSe 3/4(15 15) 3.39um

ANGLE	BTDF DATA	ANGLE	BTDF DATA
0	100084.692454	0	110510.181251
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0.4	9.20388256582	-0.4	61.5823415313
0.6	2.59382145037	-0.6	2.67749311006
0.8	1.00405991627	-0.8	1.08773157596
1	0.485295626198	-1	0.56000119918
1.2	0.217546315192	-1.2	0.376522468602
1.4	0.125507489534	-1.4	0.23428064713
1.6	0.0920388256582	-1.6	0.125507489534
1.8	0.0552232953949	-1.8	0.0619170281701
2	0.0460194128291	-2	0.0317952306819
2.2	0.0404134116299	-2.2	0.0230933780742
2.4	0.0230933780742	-2.4	0.0157804750174
2.6	0.0153955853828	-2.6	0.0119315786717
2.8	0.0115466890371	-2.8	0.00981468568155
3	0.00962224086427	-3	0.00769779269141
3.5	0.00596578933585	-3.5	0.00500356324942
4	0.00365645152842	-4	0.00346400671114
5	0.0018859592094	-5	0.00192444817285
6	0.00157804750174	-6	0.00127013579408
7	0.00123164683063	-7	0.00103920201334
8	9.622240864E-4	-8	0.082682326E-4
9	0.082682326E-4	-9	6.35067897E-4
10	6.158234153E-4	-10	5.196010067E-4
12	4.23378598E-4	-12	3.464066711E-4
15	3.271561894E-4	-15	2.694227442E-4



# SAMPLE--ZnSe 3/4(15 30) 3.39um

ANGLE	BTDF DATA	ANGLE	BTDF DATA
0	114680.37677	0	114680.37677
0.2	140.752465929	-0.2	281.504931859
0.4	8.36716596893	-0.4	32.6319472788
0.6	2.3428064713	-0.6	3.17952306819
0.8	1.00405991627	-0.8	1.08773157596
1	0.54386578798	-1	0.552232953949
1.2	0.184077651316	-1.2	0.359788136664
1.4	0.117140323565	-1.4	0.23428064713
1.6	0.0926388256582	-1.6	0.117140323565
1.8	0.0518764290074	-1.8	0.0585701617825
2	0.0451826962322	-2	0.0301217974881
2.2	0.0327156189385	-2.2	0.0250178262471
2.4	0.0192444817285	-2.4	0.017512478373
2.6	0.0127013579408	-2.6	0.0130862475754
2.8	0.0115466890371	-2.8	0.0101995753161
3	0.00962224086427	-3	0.00808268222599
3.5	0.0051960100667	-3.5	0.00500356524942
4	0.00346400671114	-4	0.00346400671114
5	0.00192444817285	-5	0.00180998128248
6	0.00157864750174	-6	0.00119315786717
7	0.00111617994026	-7	9.23735123E-4
8	9.23735123E-4	-8	7.312903057E-4
9	7.312903057E-4	-9	5.773344519E-4
10	6.158234153E-4	-10	4.811120432E-4
12	4.618675615E-4	-12	3.271561894E-4
15	3.079117077E-4	-15	2.501782625E-4



SAMPLE - ZnS<sub>2</sub> 3/4(0 0) 10.6um

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0.4  
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0.6  
0.7  
0.8  
0.9  
1  
1.1  
1.2  
1.3  
1.4  
1.5  
1.6  
1.7  
1.8  
1.9  
2  
2.5  
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3.5  
4  
4.5  
5  
6  
7  
8

BTDF DATA  
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0.072412858072  
0.0971110421571  
0.095770788082  
0.0511977388697  
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0.0134408429084  
0.0116194282076  
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ANGLE  
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2.50638962E-5  
2.313760454E-5  
2.447958207E-5  
2.12329896E-5  
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1.534584662E-5  
1.002137844E-5  
9.025775806E-6  
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5.71421961E-6  
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3.636413353E-6  
3.549857777E-6  
2.965452537E-6  
2.359393475E-6  
2.359413101E-6  
2.424372306E-6  
2.900614673E-6  
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1.536922515E-6  
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ZnSe 3/4 (0 0) 10.6  $\mu\text{m}$

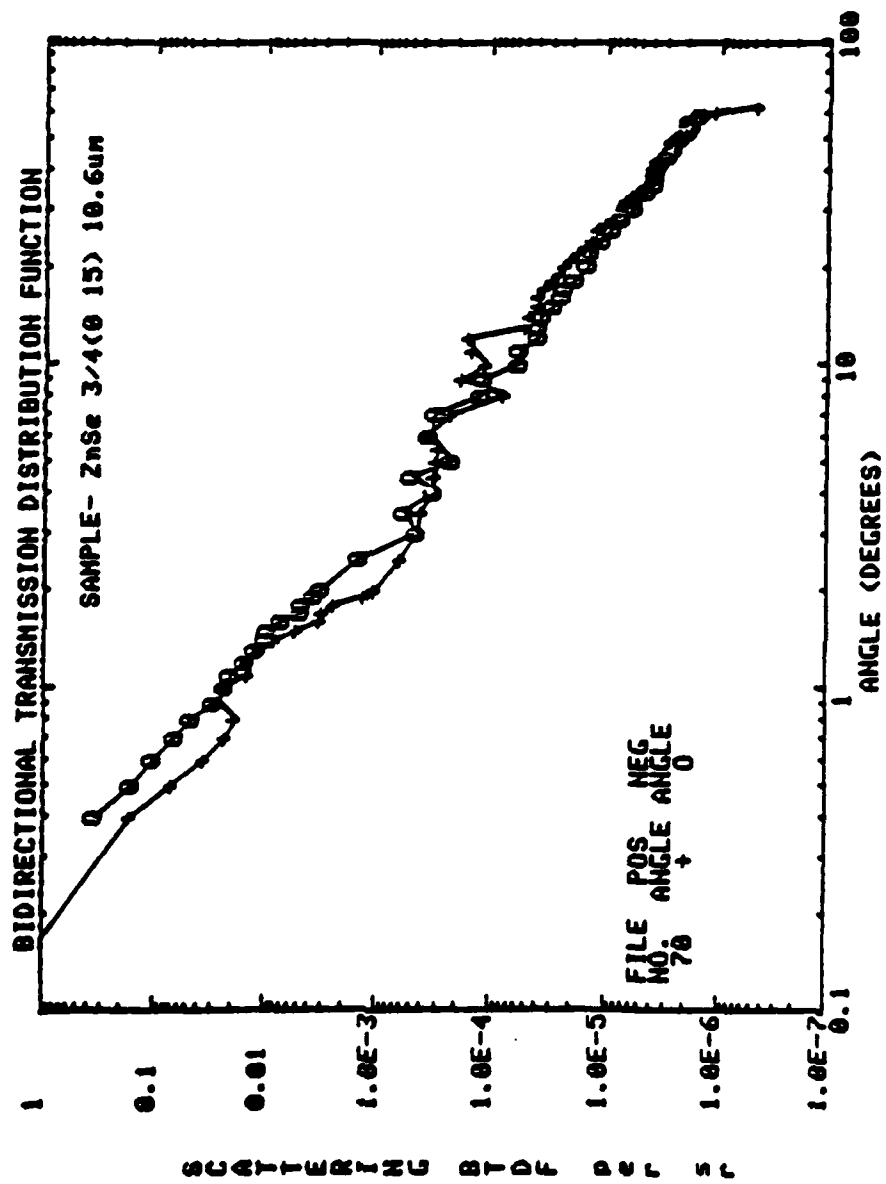
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-4  
-3.5

BTDF DATA  
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1.902740328E-6  
1.928611755E-6  
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2.813871962E-6  
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-1.7  
-1.6  
-1.5  
-1.4  
-1.3  
-1.2  
-1.1  
-1  
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-0.3  
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-0.1  
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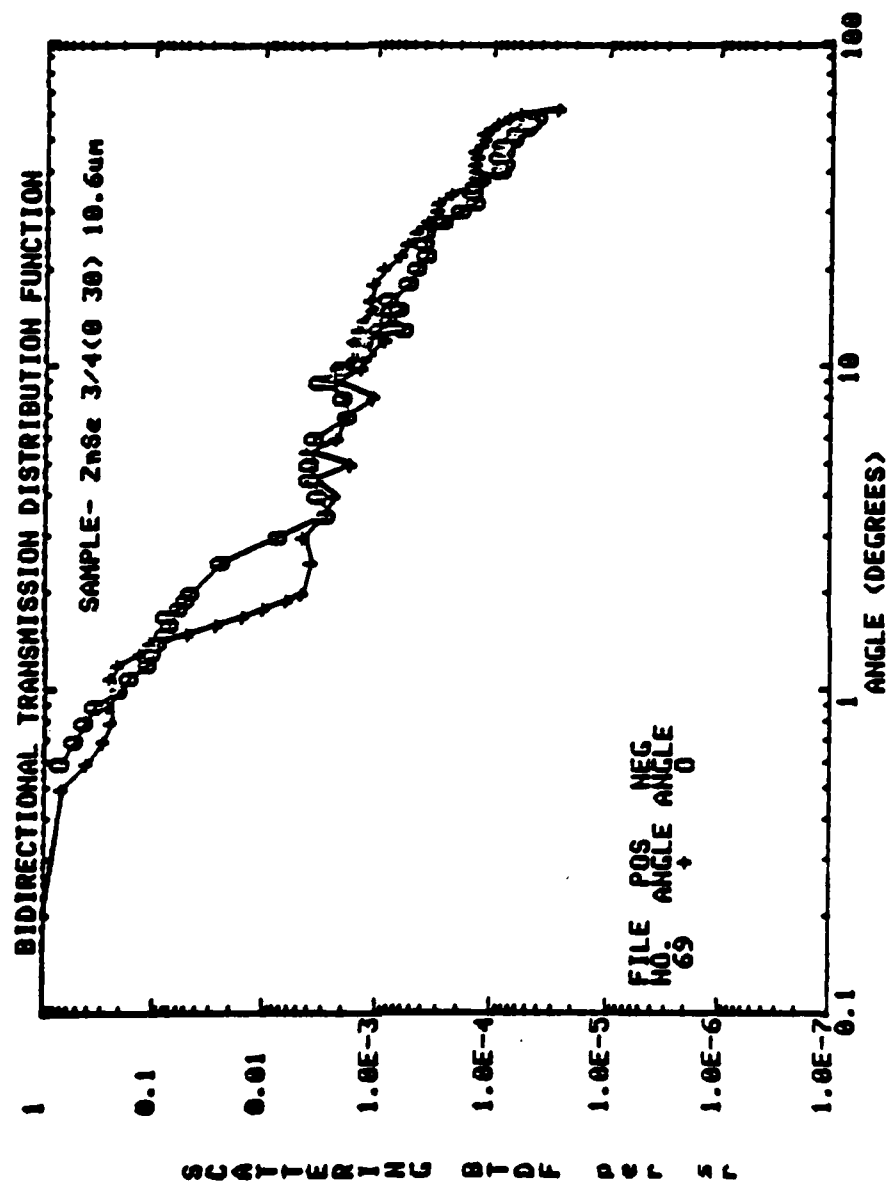
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0.152329544835  
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0.657107826744  
0.677786041609  
1.14189715686  
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2704.71091664  
16749.3565786  
1880.3392882





SAMPLE - ZnSe 3/4(0 15) 10.6um

ANGLE	BTDF DATA	ANGLE	BTDF DATA	ANGLE	BTDF DATA
0	15654.7895578	41	3.766326674E-6	-20	1.456659312E-5
0.1	15861.5717449	42	3.203354565E-6	-18	1.878715935E-5
0.2	2743.31025694	44	3.749018086E-6	-17	2.328911365E-5
0.3	1.78521949295	46	2.749041045E-6	-16	2.450114896E-5
0.4	0.159528623591	48	2.554249394E-6	-15	2.839705053E-5
0.5	0.0678551901543	50	2.294516085E-6	-14	3.666504488E-5
0.6	0.0342333932255	52	1.850702851E-6	-13	3.882940266E-5
0.7	0.0220950593426	54	1.733908359E-6	-12	5.692369096E-5
0.8	0.01807429477	56	1.729596655E-6	-11	3.876442559E-5
0.9	0.0255414294632	58	1.437377133E-6	-10	5.804912182E-5
1	0.0224779898457	60	1.097527389E-6	-9	1.180427669E-4
1.1	0.0135174284376	62	4.632613817E-7	-8	1.215390012E-4
1.2	0.0135124338428	64	1.591072579E-6	-7	3.013499165E-4
1.3	0.0107653275309	66	1.922255106E-6	-6	3.446375419E-4
1.4	0.0078983474244	68	1.868118494E-6	-5	2.2143367E-4
1.5	0.0051479111646	70	1.9676744E-6	-4	4.861550179E-4
1.6	0.0031583401098	72	2.294516085E-6	4	3.130038539E-4
1.7	0.0029602154908	74	2.619187937E-6	5	5.67735615E-4
1.8	0.0023258836440	76	2.662457075E-6	6	4.478617519E-4
1.9	0.0012819831328	78	2.922184579E-6	7	0.00141517635899
2	0.0018339110908	80	3.484947872E-6	8	0.0030917437933
2.5	6.076933777E-4	82	3.766312519E-6	9	0.00363450542739
3	4.12020976E-4	84	3.896130409E-6	10	0.00459682515472
3.5	3.995793185E-4	86	4.58075038E-6	11	0.0047766356953
4	3.14668768E-4	88	5.84088237E-6	12	0.00701261380657
4.5	3.063442579E-4	90	7.402471926E-6	13	0.00929187975738
5	3.013495809E-4	92	8.939197621E-6	14	0.00953495693505
5.5	2.847005022E-4	94	1.095208961E-5	15	0.0119857087682
6	3.679463612E-4	96	1.365758705E-5	16	0.0148110659766
7	2.147742499E-4	98		17	0.0196293239659
		100		18	0.0224396968477
				19	0.028221939302
				20	0.0459515968728



SAMPLE - ZnSe 3/4(0 30) 10.6um

ANGLE  
0  
0.1  
0.2  
0.3  
0.4  
0.5  
0.6  
0.7  
0.8  
0.9  
1  
1.1  
1.2  
1.3  
1.4  
1.5  
1.6  
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1.8  
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4.5  
5  
5.5  
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7

BTDF DATA  
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185945.575945  
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0.401124889068  
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0.00965502754871  
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0.00428561076635  
0.00289758824991  
0.0022679439404  
0.00360418687124  
0.00167102265607  
0.00403030481841  
0.00220321950482  
0.00192885205678

ANGLE  
0  
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BTDF DATA  
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4.487840035E-4  
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3.015514625E-4  
2.902643714E-4  
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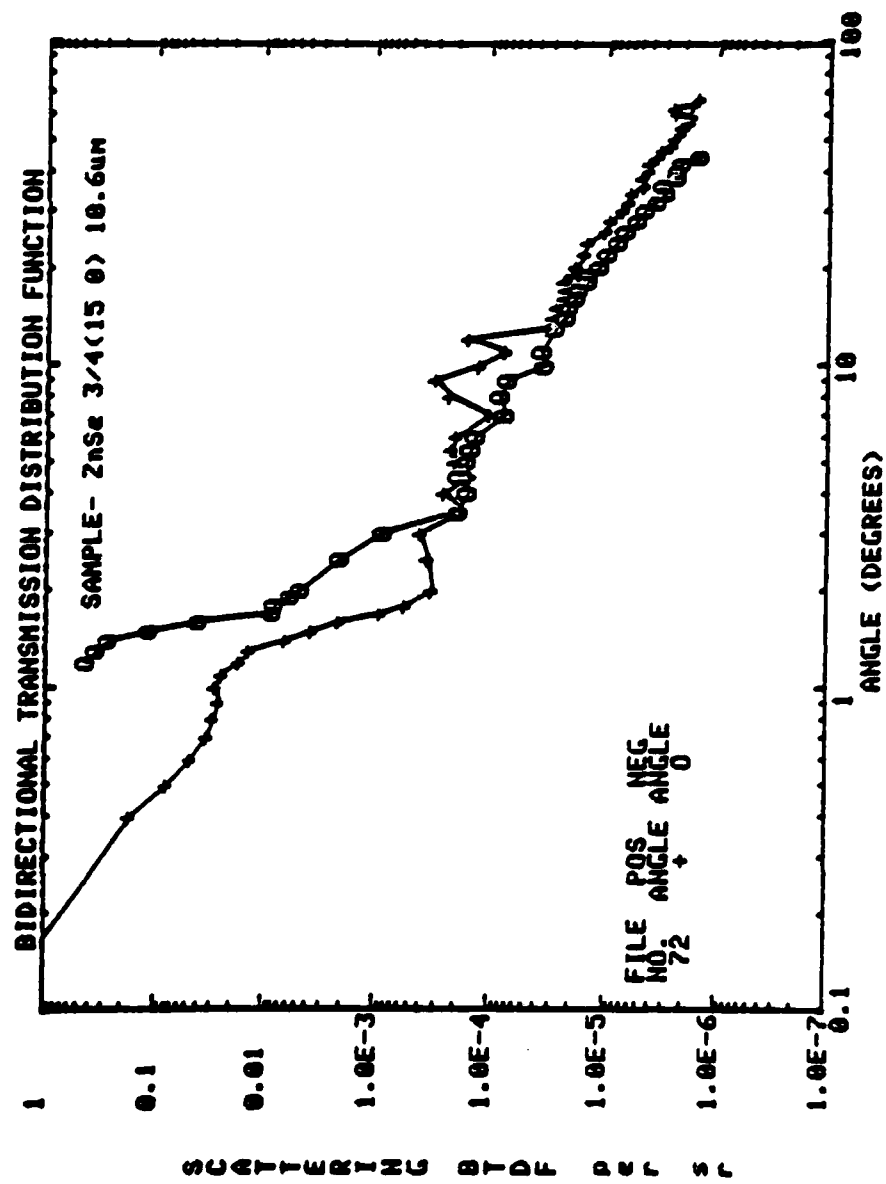
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-14  
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-12

BTDF DATA  
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6.454121248E-5  
6.656728545E-5  
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7.881864132E-5  
8.912335665E-5  
7.92488989E-5  
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1.248931987E-4  
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1.859020751E-4  
2.654743293E-4  
3.784457414E-4  
3.900260113E-4  
3.716934093E-4  
4.481568714E-4  
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7.807481254E-4  
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8.002025342683  
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5.854551674E-4  
8.001297485955

ZnSe 3/4 (0 30) 10.6  $\mu$ m

ANGLE  
-11  
-10  
-9  
-8  
-7  
-6  
-5  
-4.5  
-4  
-3.5  
-3  
-2.5  
-2  
-1.9  
-1.8  
-1.6  
-1.7  
-1.5  
-1.4  
-1.3  
-1.2  
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0.0233230977379  
0.044233326125  
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0.0746475655974  
0.0677362190678  
0.0752085258495  
0.0893476555888  
0.0996679252599  
0.109204285713  
0.16032738091  
0.202025587182  
0.340996835826  
0.420394592004  
0.514762133875  
0.687708371257  
1.2424094918  
2.00865886691  
4.84690223119  
435.595942461  
44586.4124323  
223127.545232



SAMPLE -- ZnSe 3/4(15 0) 10.6um

ANGLE  
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 2 2.5 3 3.5 4 4.5 5 5.5 6 7 8

BTDF DATA  
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1.725260067E-4  
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9.953440434E-5  
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ANGLE  
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BTDF DATA  
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1.509611786E-4  
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2.311874635E-5  
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2.33577049E-5  
2.04877948E-5  
1.846061482E-5  
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1.447099731E-5  
1.017934787E-5  
9.230471862E-6  
7.31109066E-6  
6.405328669E-6  
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4.550644463E-6  
4.852616281E-6  
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4.20566322E-6  
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ZnSe 3/4 (15 0) 10.6  $\mu$ m

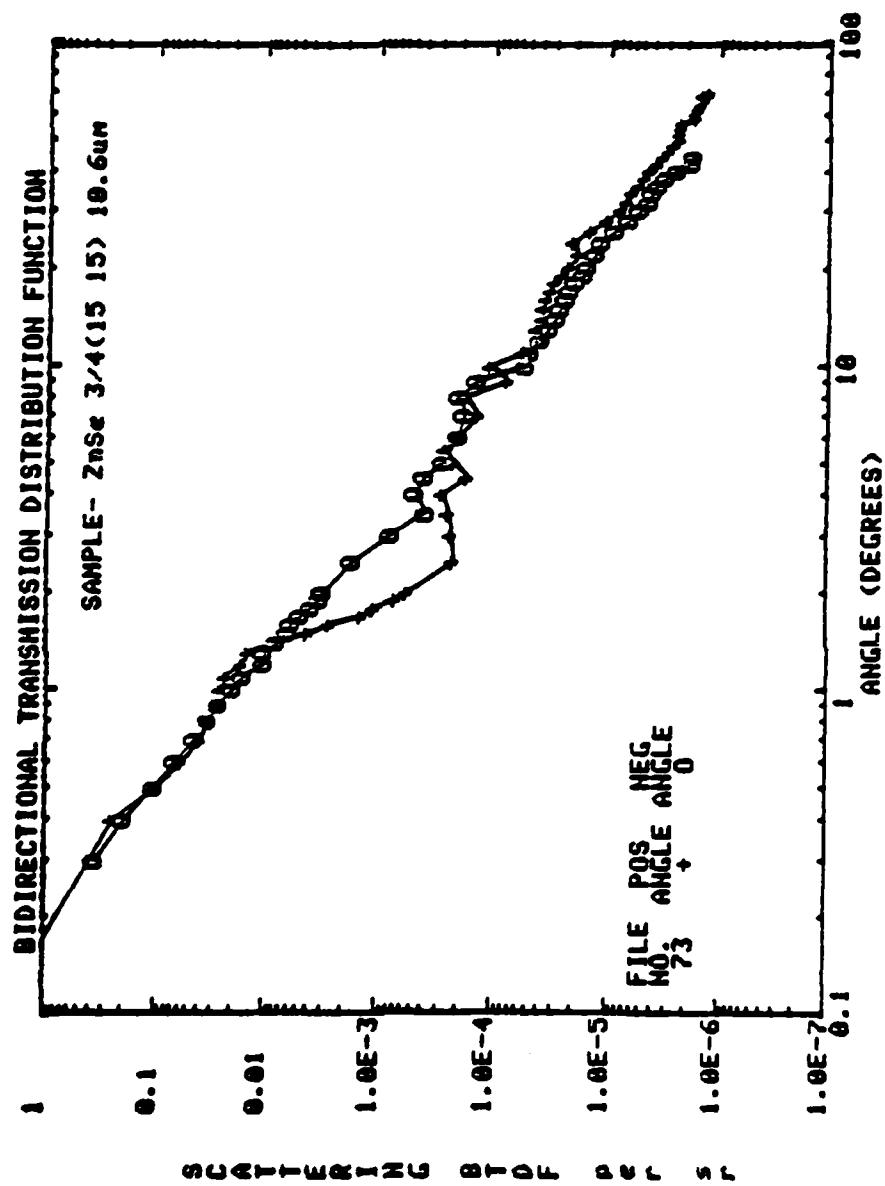
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-17  
-16  
-15  
-14  
-13  
-11  
-10  
-9  
-8  
-7  
-6  
-5.5  
-5  
-4.5

BTDF DATA  
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1.46228842E-6  
2.111458611E-6  
2.329272674E-6  
2.350822998E-6  
3.084086058E-6  
2.976231549E-6  
3.601649453E-6  
4.528994214E-6  
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2.132873811E-5  
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2.743183456E-5  
3.588559045E-5  
3.359957659E-5  
6.967418648E-5  
8.128648678E-5  
7.415313123E-5  
1.335419119E-4  
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ANGLE  
-4  
-3.5  
-3  
-2.5  
-2  
-1.9  
-1.8  
-1.7  
-1.6  
-1.5  
-1.4  
-1.3  
-1.2  
-1.1  
-1  
-0.9  
-0.8  
-0.7  
-0.6  
-0.5  
-0.4  
-0.3  
-0.2  
-0.1  
0

BTDF DATA  
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0.0388415586967  
0.111869792201  
0.26109310291  
0.336563237165  
0.422640396195  
7.99189820731  
11.4500938654  
12.3941953857  
9.93550194857  
70.6931562296  
535.006169405  
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7702.98986772  
17111.955713  
16947.1271062





SAMPLE - ZnSe 3/4(15 15) 10.6um

ANGLE  
0  
0.1  
0.2  
0.3  
0.4  
0.5  
0.6  
0.7  
0.8  
0.9  
1  
1.1  
1.2  
1.3  
1.4  
1.5  
1.6  
1.7  
1.8  
1.9  
2  
2.5  
3  
3.5  
4  
4.5  
5  
5.5  
6  
7

BTDF DATA  
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0.0959239567362  
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0.0372973792022  
0.0322427038057  
0.0260392384333  
0.0249670347179  
0.0227077480552  
0.0162745244965  
0.0139902640338  
0.0079016772505  
0.0040324194180  
0.0026205731855  
0.0013835427894  
0.0010605496644  
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2.214334773E-4  
2.330879006E-4  
2.49737074E-4  
2.780406575E-4  
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2.197687552E-4  
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2.01454795E-4  
1.376806083E-4

ANGLE  
0  
9  
10  
11  
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38  
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42  
44  
46  
48  
50  
52  
54  
56  
58  
60

BTDF DATA  
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2.209963674E-5  
1.86574327E-5  
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1.470322512E-5  
1.051930221E-5  
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4.502258643E-6  
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2.402747976E-6  
2.402770719E-6  
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2.272936781E-6  
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1.716645404E-6

AD-A124 458

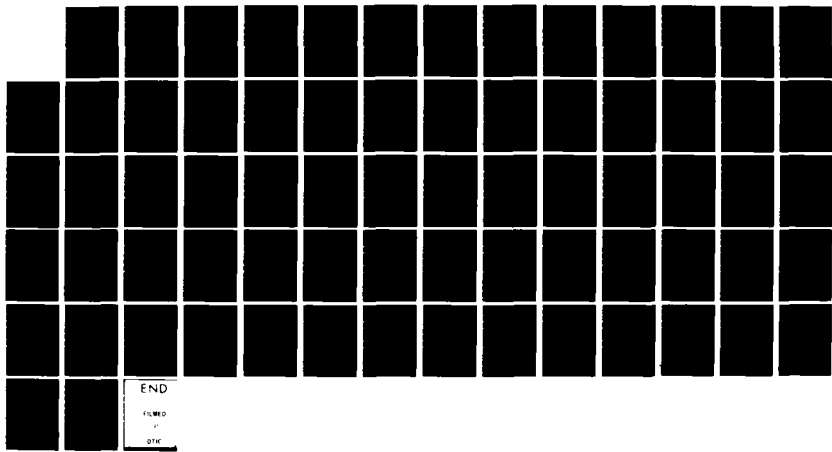
SCATTERING MEASUREMENTS OF RAYTRAN ZINC ELENIDE IN  
TRANSMISSION AT WAVELENGTH (U) ARIZONA UNIV TUCSON OPTICAL  
SCIENCES CENTER F O BARELL ET AL. AUG 81  
AMMRC-TR-81-38 DAAG46-79-M-8871

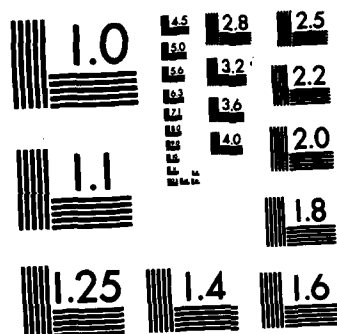
2/2

UNCLASSIFIED

F/G 20/6

NL





MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A

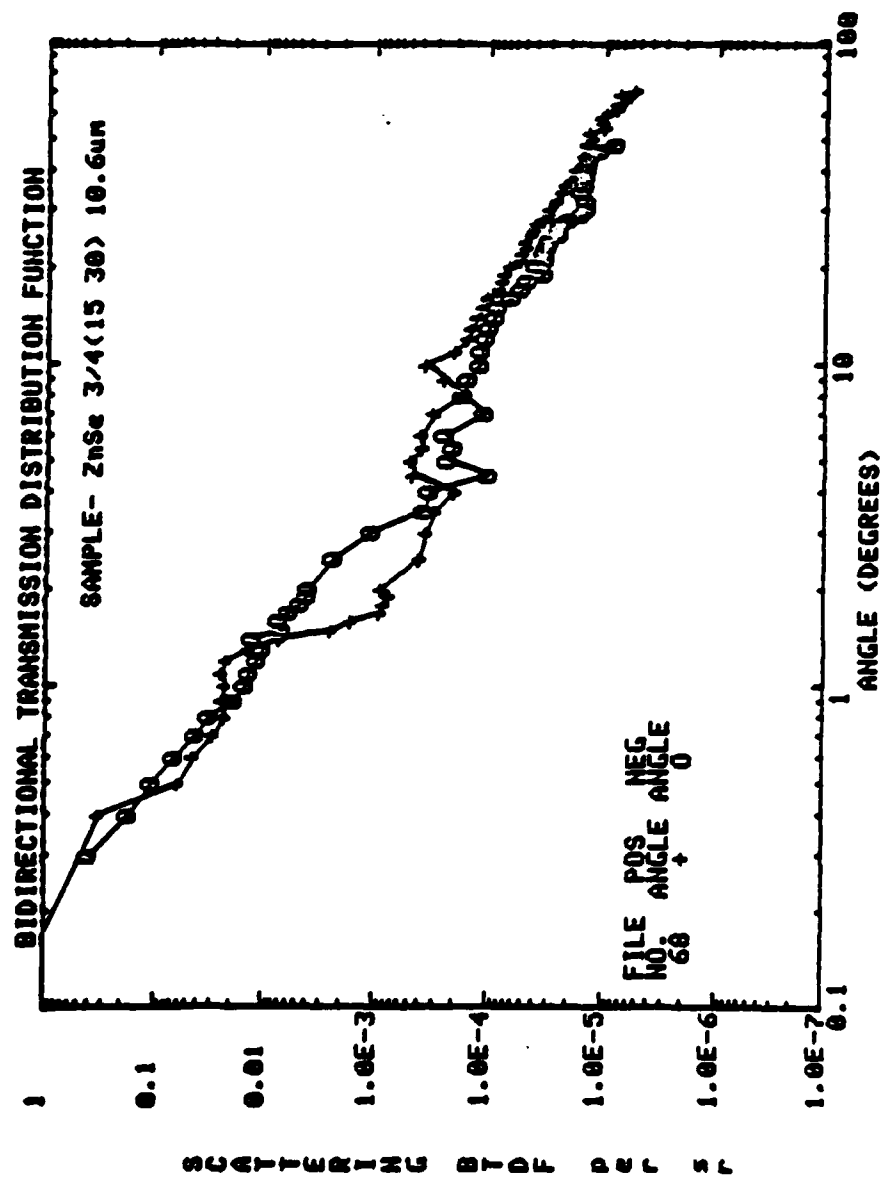
ZnSe 3/4 (15 15) 10.6  $\mu$ m

ANGLE  
62  
64  
66  
68  
69  
-13  
-14  
-12  
-10  
-38  
-36  
-34  
-32  
-30  
-28  
-26  
-24  
-22  
-20  
-19  
-18  
-17  
-16  
-15  
-14  
-13  
-12  
-11  
-10  
-9  
-8  
-7

BTDF DATA  
1.618590972E-6  
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3.744614227E-6  
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5.389548041E-6  
6.6016197E-6  
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ANGLE  
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-5  
-4.5  
-4  
-3.5  
-3  
-2.5  
-2  
-1.9  
-1.8  
-1.7  
-1.6  
-1.5  
-1.4  
-1.3  
-1.2  
-1.1  
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-0.9  
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-0.7  
-0.6  
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-0.3  
-0.2  
-0.1  
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0.0191464990160  
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0.0646768717582  
0.101323269271  
0.108171785003  
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179.211222566  
14196.2859163



ZnSe 3/4 (15 30) 10.6  $\mu$ m

ANGLE

7  
8  
9  
10  
11  
12  
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30  
32  
34  
36  
38  
40  
42  
44  
46  
48

BTDF DATA

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ANGLE

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0.1  
0.2  
0.3  
0.4  
0.5  
0.6  
0.7  
0.8  
0.9  
1  
1.1  
1.3  
1.4  
1.5  
1.6  
1.7  
1.8  
1.9  
2  
2.5  
3  
3.5  
4  
4.5  
5  
5.5  
6  
7

BTDF DATA

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ZnSe 3/4 (15 30) 10.6 μm

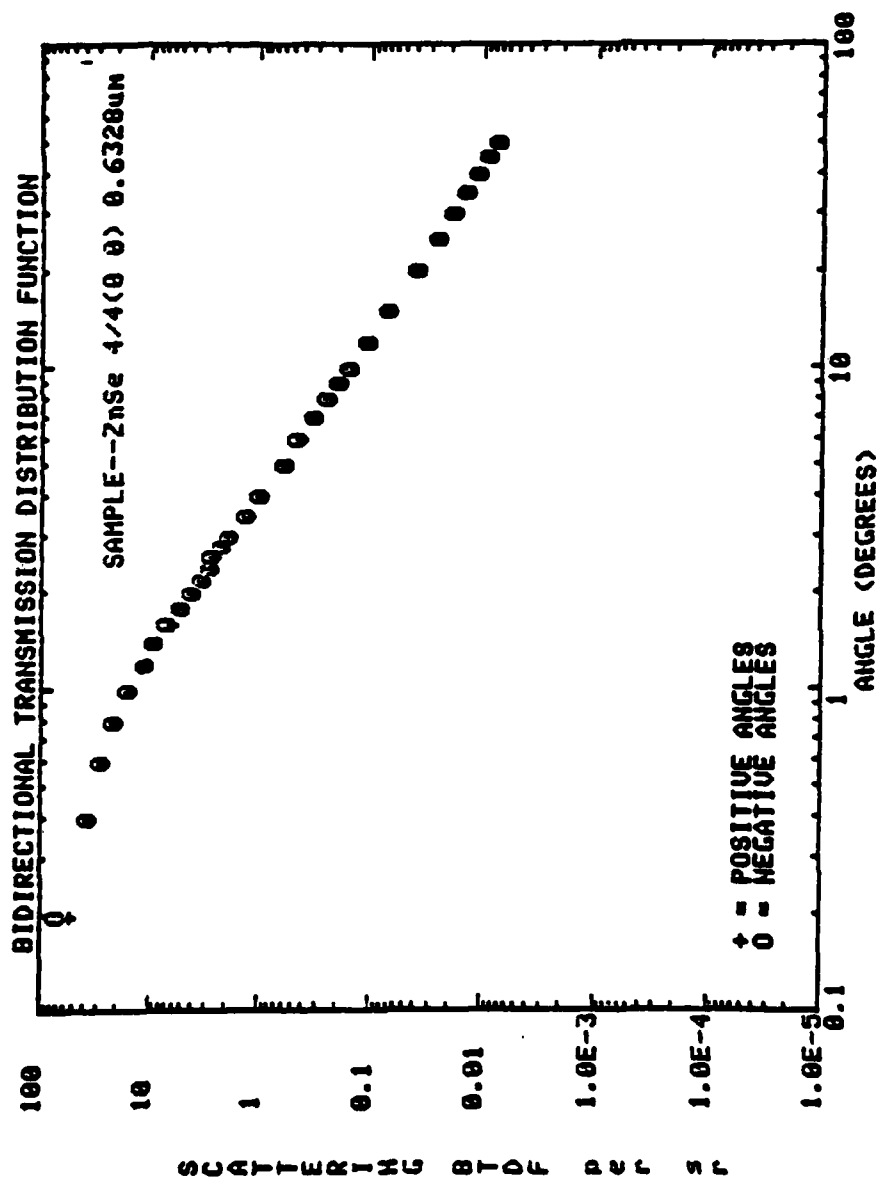
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86  
88  
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92  
94  
96  
98  
100

BTDF DATA  
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ANGLE  
-19  
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-7  
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3  
4  
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16  
17  
18  
19

BTDF DATA  
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1.720053669E-4  
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2.390178928E-4  
2.037422926E-4  
2.299202086E-4  
1.021228102E-4  
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0.00384182845619  
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0.00449088299302  
0.00576166362629  
0.00714643332433  
0.00660777180633  
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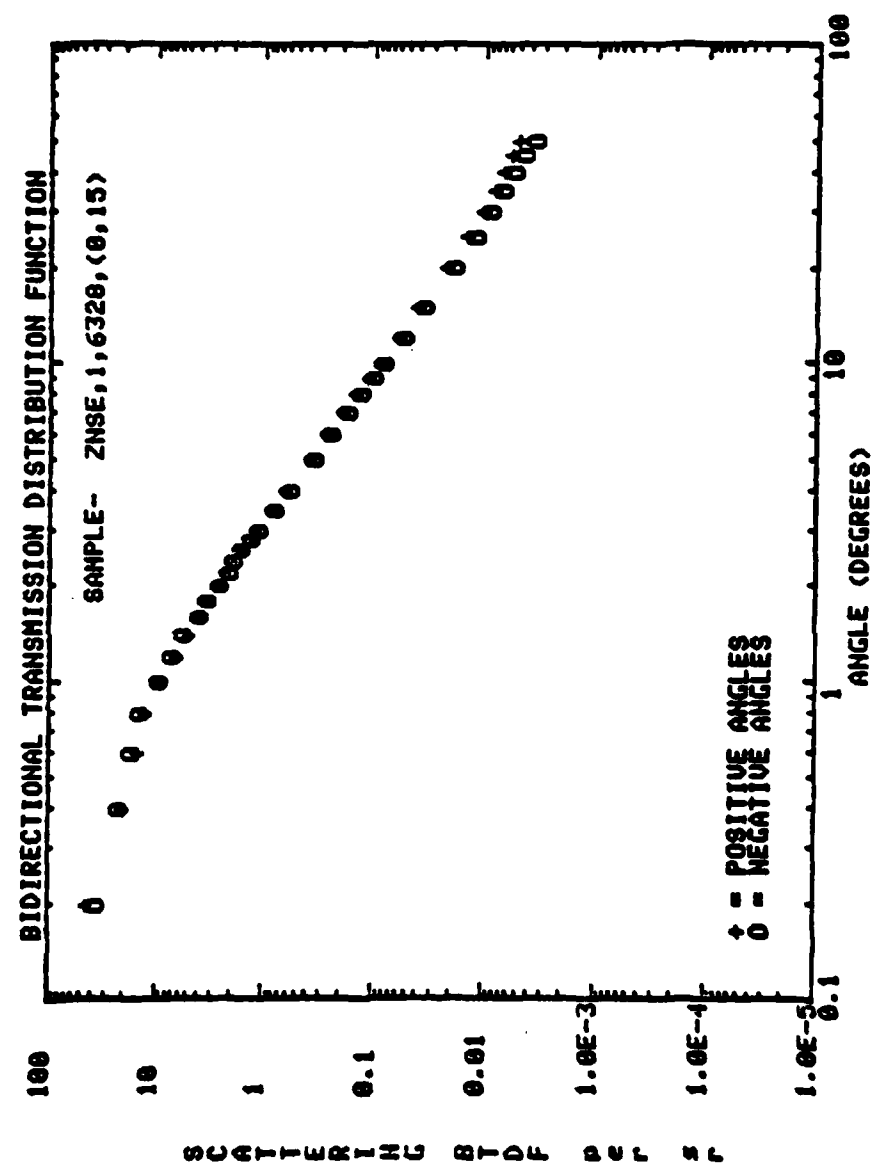
SAMPLE--ZnSe 4/4(0 0) 0.6328um 2/6/88

ANGLE  
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0.4  
0.6  
0.8  
1  
1.2  
1.4  
1.6  
1.8  
2  
2.2  
2.4  
2.6  
2.8  
3  
3.5  
4  
5  
6  
7  
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9  
10  
12  
15  
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25  
30  
35  
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45  
50

BTDF DATA  
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19.55377136336  
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10.6436540732  
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3.02049690265  
2.66091405163  
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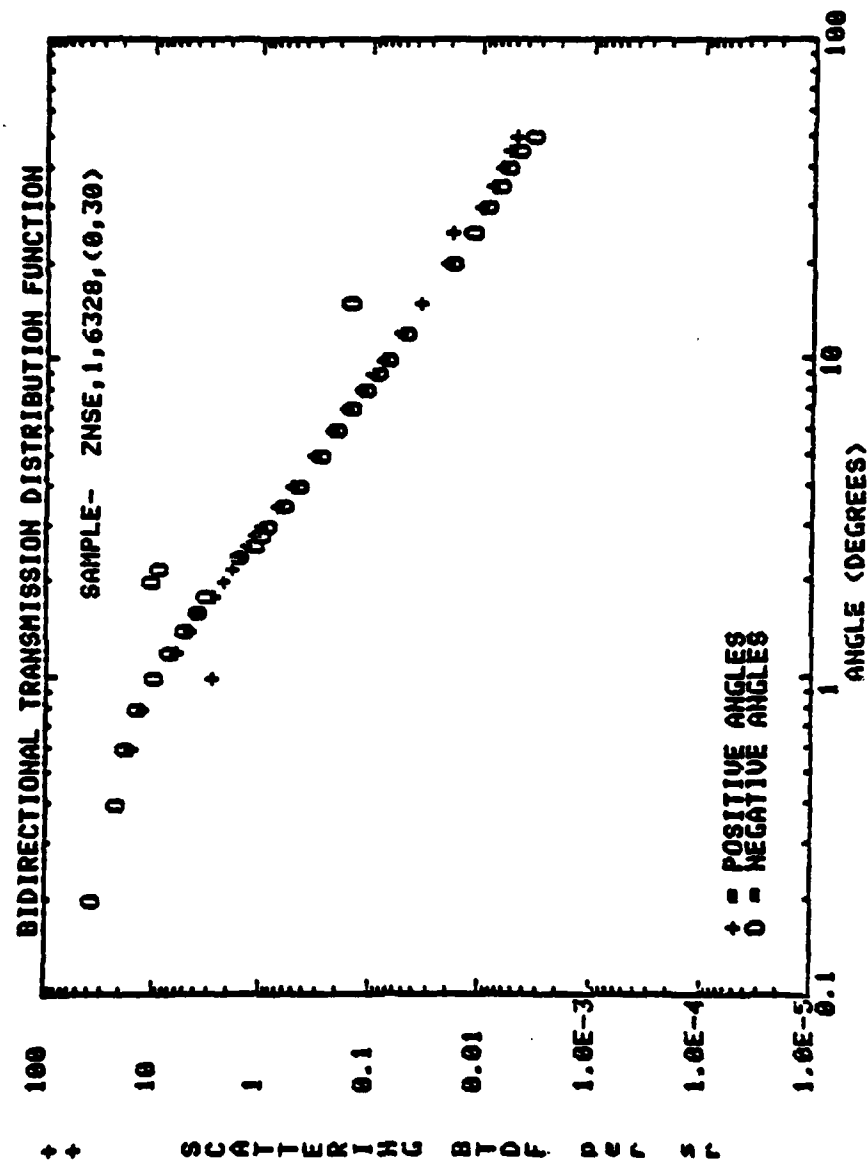
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-1.4  
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-1.8  
-2  
-2.2  
-2.4  
-2.6  
-2.8  
-3  
-3.5  
-4  
-5  
-6  
-7  
-8  
-9  
-10  
-12  
-15  
-20  
-25  
-30  
-35  
-40  
-45  
-50

BTDF DATA  
166666.666667  
68.1942281354  
35.4022669668  
27.0819187604  
20.7192995618  
15.1724007199  
10.720897809  
8.82309934136  
6.7921219462  
5.02750218742  
3.92877668234  
3.15629301868  
2.73016706999  
2.61473439579  
2.11477429861  
1.80445425408  
1.27576084334  
0.94820079178  
0.580414060358  
0.439810555202  
0.32048230329  
0.24121424189  
0.188368867504  
0.150865696558  
0.103986737592  
0.0682482120141  
0.0383668739427  
0.0249018367927  
0.0177031987708  
0.0137978462673  
0.0108035173011  
0.00878077354838  
0.00715759501084



SAMPLE--ZnSe 4/4(0 15) 0.6320um

ANGLE	BTDF DATA	BTDF DATA	BTDF DATA
0	93247.5884244	0	98070.7395498
0.2	42.0900322325	-0.2	33.9514112813
0.4	19.9214086481	-0.4	21.3183281325
0.6	14.3944268213	-0.6	16.2165061658
0.8	12.1471957876	-0.8	13.787067219
1	8.89960741541	-1	9.66752453645
1.2	6.27170455908	-1.2	6.85101867851
1.4	4.90310015291	-1.4	5.3145771178
1.6	3.90407334607	-1.6	3.76134378365
1.8	3.14844634681	-1.8	3.19342563143
2	2.57234774427	-2	2.48303011426
2.2	2.17935025716	-2.2	1.98285146348
2.4	1.87567038336	-2.4	1.80421627351
2.6	1.56334454177	-2.6	1.53328022366
2.8	1.31948958321	-2.8	1.25267998406
3	1.13242276653	-3	1.06561316379
3.5	0.818417757837	-3.5	0.754948624859
4	0.681286619989	-4	0.554519882879
5	0.364112605256	-5	0.337368744319
6	0.251666193836	-6	0.234580599025
7	0.181015059608	-7	0.167623639382
8	0.135684936053	-8	0.126525920535
9	0.10620797327	-9	0.0969724973335
10	0.0845046793121	-10	0.0775703562537
12	0.0581836684679	-12	0.0521005915625
15	0.0374334025593	-15	0.0338963881443
20	0.0212222580008	-20	0.0184712252525
25	0.0138535635593	-25	0.011790266059
30	0.00992360122241	-30	0.00854805253812
35	0.00789969870606	-35	0.00670690820656
40	0.006552424279602	-40	0.00525673177089
45	0.00551230780739	-45	0.00425459764812
50	0.00476529958643	-50	0.00333605183954



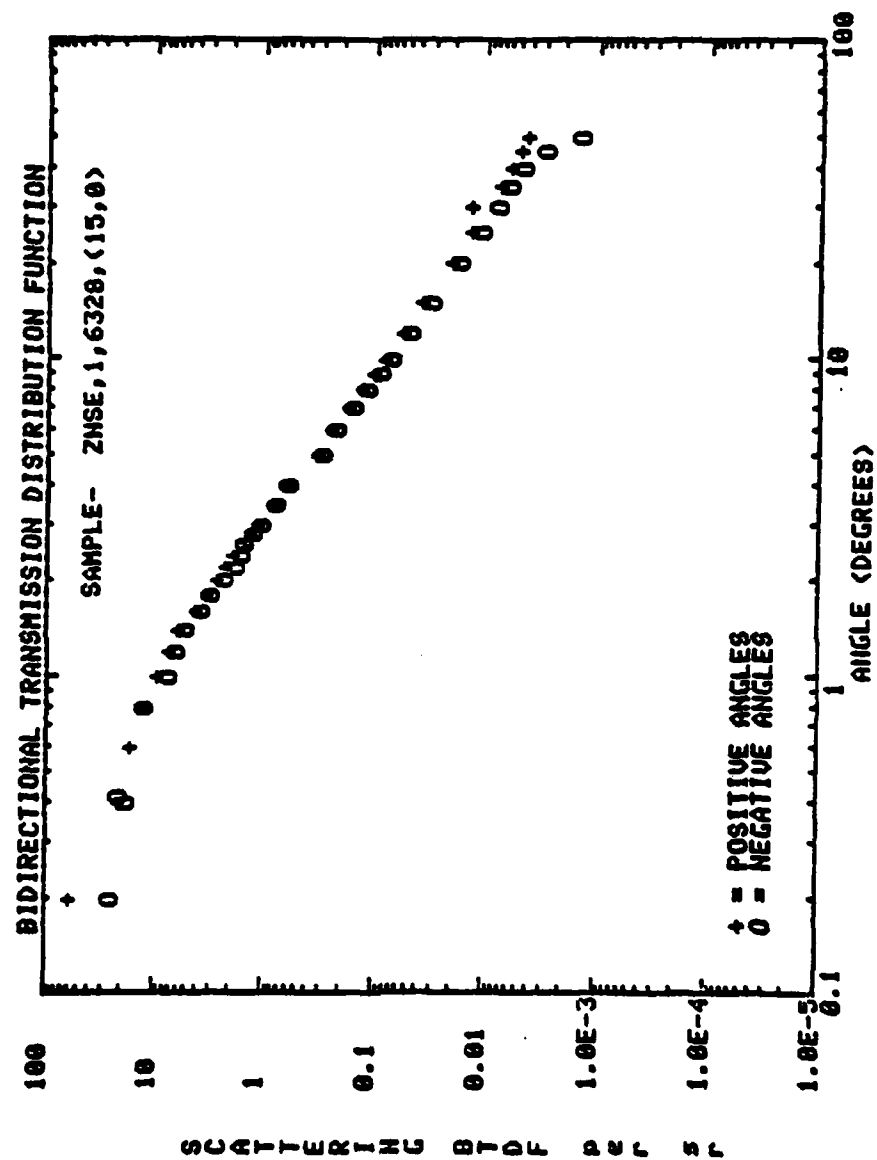
SAMPLE--ZnSe 4/4(0 30) 0.6328um

ANGLE  
0 0.2 0.4 0.6 0.8 1 1.2 1.4 1.6 1.8 2 2.2 2.4 2.6 2.8 3 3.5 4 5 6 7 8 9 10 12 15 20 25 30 35 40 45 50

BTDF DATA  
101022.079314  
376.563058934  
217.434799756  
15.3662024717  
12.2079317666  
2.68667393673  
5.84351593167  
4.3406577236  
3.4590929439  
2.56073636207  
2.05430549021  
1.73276208971  
1.55769999456  
1.29610615856  
1.09557742606  
0.945355878047  
0.668096128194  
0.497731702102  
0.310664803383  
0.216109685716  
0.156541084712  
0.119137545614  
0.0951254021462  
0.0757309694382  
0.052642366709  
0.0345841409472  
0.0197484508285  
0.0170819047361  
0.00962884079086  
0.00766388600516  
0.00533755512566  
0.00340422334057  
0.00474599527772

ANGLE  
0 -0.2 -0.4 -0.6 -0.8 -1 -1.2 -1.4 -1.6 -1.8 -2 -2.2 -2.4 -2.6 -2.8 -3 -3.5 -4 -5 -6 -7 -8 -9 -10 -12 -15 -20 -25 -30 -35 -40 -45 -50

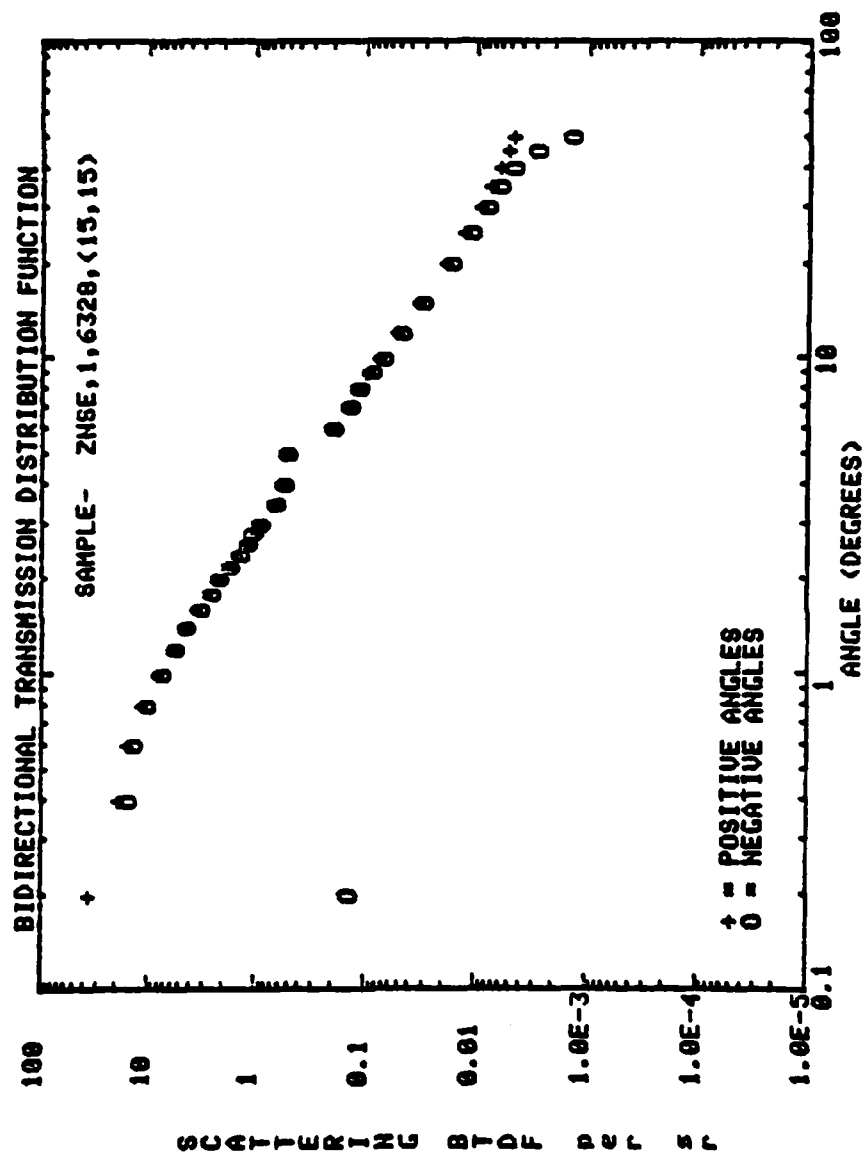
BTDF DATA  
1039657.02036  
35.1661308262  
21.0753842222  
17.7349056195  
13.6655952611  
9.57127589959  
6.05941453473  
4.81922150865  
3.69417693037  
3.10646706219  
10.0750208665  
8.47981612356  
1.51839983415  
1.09557737115  
0.928653428181  
0.808396193219  
0.591265073451  
0.430922077659  
0.273919574596  
0.195329908244  
0.143149664486  
0.108516756664  
0.084956378616  
0.0603425821759  
0.0466392898036  
0.147306825347  
0.017506964691  
0.0114955101875  
0.00835154558322  
0.00661255874343  
0.00552202477615  
0.00443146313927  
0.00327200370079



SAMPLE--ZnSe 4/4(15 0) 0.6320um

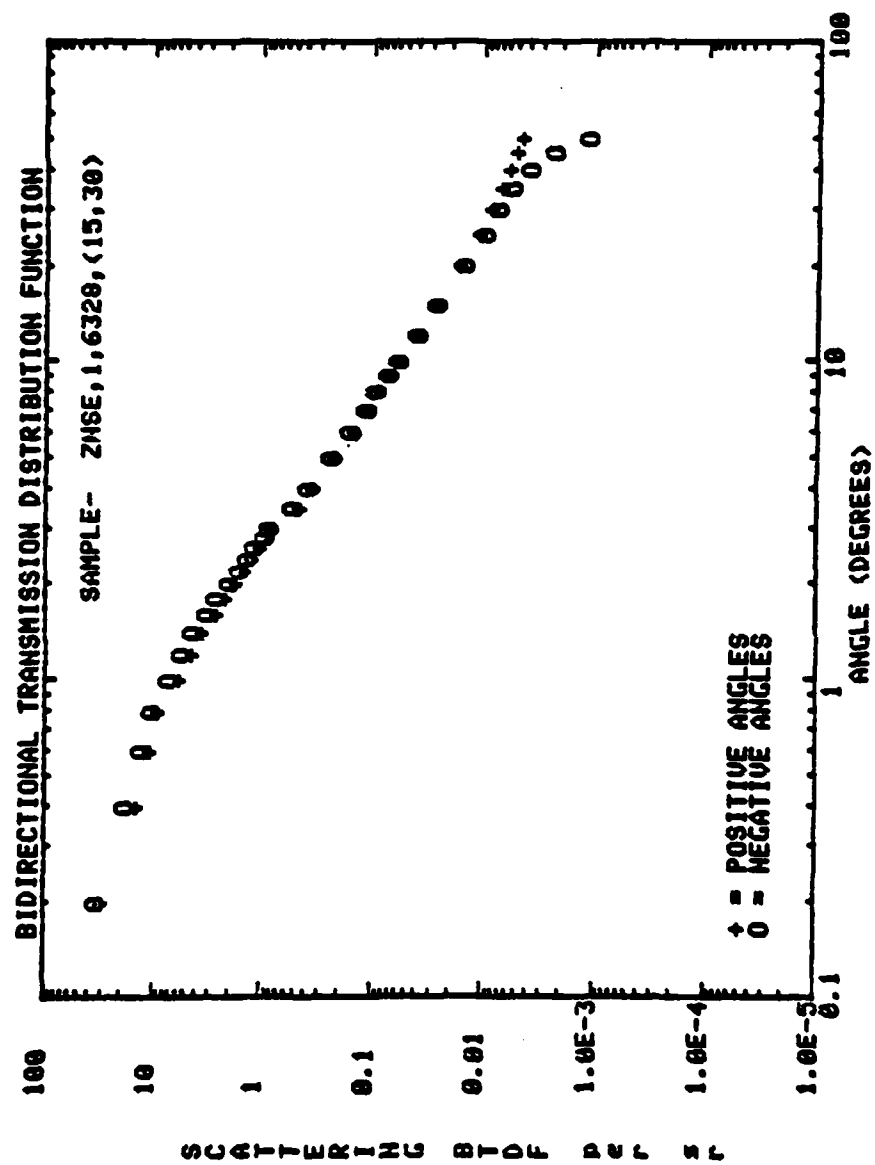
SAMPLE-ZNSE,1,6320,(15,0)		BTDF DATA	
ANGLE		BTDF DATA	
0	94527.3631841	0	89552.238806
0.2	56.3847430563	-0.2	24.1326700282
0.4	20.3548923567	-0.4	17.3101162147
0.6	15.9568825219	-0.6	23217.2474856
0.8	12.4610285624	-0.8	12.06633535
1	9.134328782	-1	7.21724743269
1.2	7.00713147976	-1.2	6.09739675827
1.4	5.65650134448	-1.4	4.98039103008
1.6	3.88159250083	-1.6	3.55422927787
1.8	3.10215635355	-1.8	2.89176856073
2	2.50159051408	-2	2.17462726925
2.2	2.16683299072	-2.2	1.74593737382
2.4	1.79270362999	-2.4	1.5276952673
2.6	1.44444489747	-2.6	1.42706114435
2.8	1.23548966997	-2.8	1.1791049065
3	1.07794406537	-3	1.6015879305
3.5	0.774461468357	-3.5	0.741293953652
4	0.595356992534	-4	0.582069984344
5	0.310116445939	-5	0.28474328218
6	0.235622284096	-6	0.212272328014
7	0.167695240276	-7	0.151562533617
8	0.12651447185	-8	0.112504480031
9	0.0997682024644	-9	0.0866072906499
10	0.0793903864133	-10	0.0696255383304
12	0.0543419882661	-12	0.0462755993829
15	0.0356637222127	-15	0.0300998167012
20	0.0190842827629	-20	0.016506397546
25	0.0133171357462	-25	0.0105807379902
30	0.0131348768182	-30	0.00757079705494
35	0.03720504802587	-35	0.00591990527695
40	0.00581966915610	-40	0.00453350402919
45	0.0048437386523	-45	0.00289164812199
50	0.00420529704860	-50	0.00136831791172





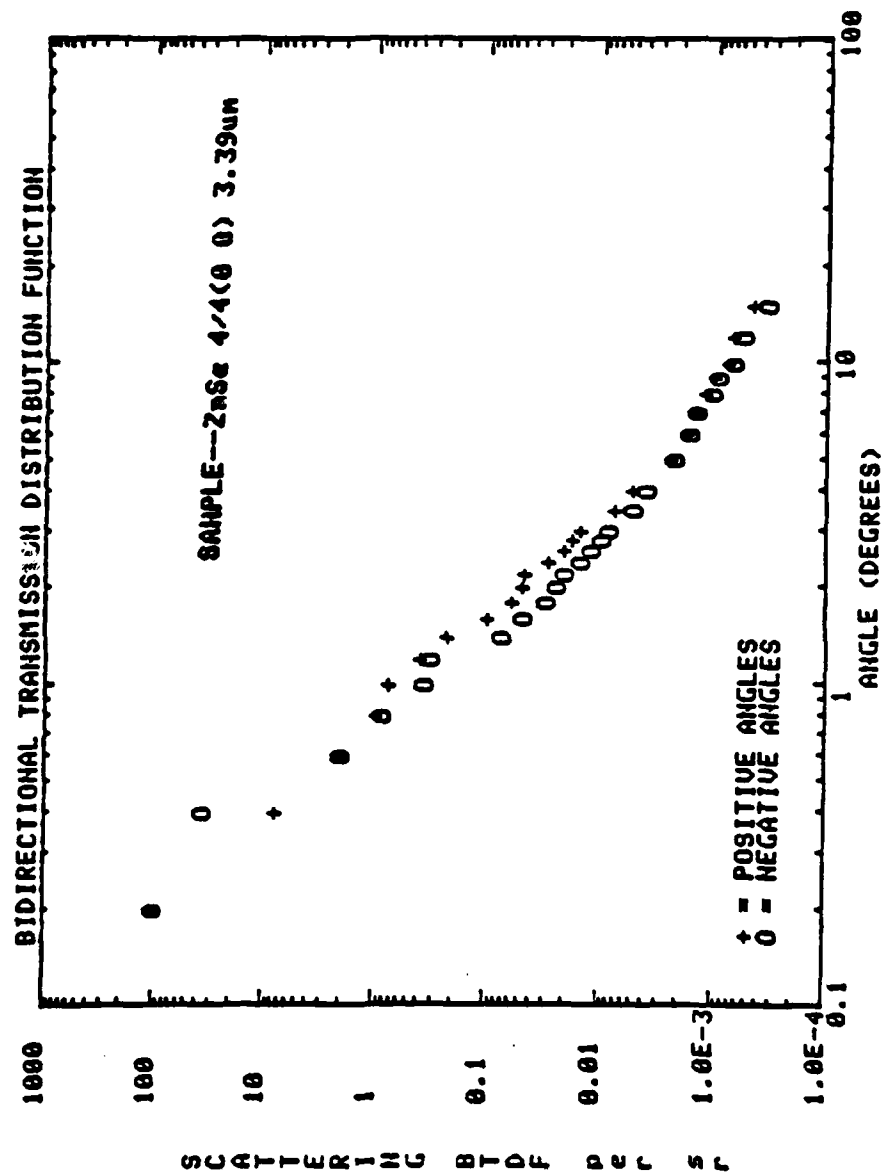
SAMPLE--ZnSe 4/4(15 15) 0.6328um

SAMPLE-ZNSE,1,6328,<15,15>		BTDF DATA	
ANGLE			
0	92039.800995		
0.2	33.6053068617		
0.4	18.1558873653		
0.6	15.1111113635		
0.8	11.0514099467		
1	7.6930351028		
1.2	5.50281960479		
1.4	4.30248795344		
1.6	3.30480967942		
1.8	2.50978478855		
2	2.07338055061		
2.2	1.6212275614		
2.4	1.40298544956		
2.6	1.15920434367		
2.8	0.987131341572		
3	0.83250449356		
3.5	0.605307143363		
4	0.504146311227		
5	0.474295740847		
6	0.193963839723		
7	0.140398329131		
8	0.114627206038		
9	0.0900036549891		
10	0.0730218976636		
12	0.0496719736495		
15	0.0324354961416		
20	0.0185529147914		
25	0.012225766438		
30	0.00893901339010		
35	0.00717868328653		
40	0.00590176400259		
45	0.00503529093798		
50	0.00445903851161		
BTDF DATA		BTDF DATA	
ANGLE		ANGLE	
0	92039.800995	0	87064.6766169
0.2	33.6053068617	0.2	8.133913764759
0.4	18.1558873653	0.4	14.5472637896
0.6	15.1111113635	0.6	13.0248758394
0.8	11.0514099467	0.8	9.9237150542
1	7.6930351028	1	6.99154261294
1.2	5.50281960479	1.2	5.34393236386
1.4	4.30248795344	1.4	4.18557251992
1.6	3.30480967942	1.6	3.04755571852
1.8	2.50978478855	1.8	2.40845807349
2	2.07338055061	2	2.01094564683
2.2	1.6212275614	2.2	1.61343319813
2.4	1.40298544956	2.4	1.30165872265
2.6	1.15920434367	2.6	1.11940333616
2.8	0.987131341572	2.8	1.00829224072
3	0.83250449356	3	0.855721750353
3.5	0.605307143363	3.5	0.62023252498
4	0.504146311227	4	0.52736357556
5	0.474295740847	5	0.482587624429
6	0.193963839723	6	0.104942265782
7	0.140398329131	7	0.131940598461
8	0.114627206038	8	0.108683573133
9	0.0900036549891	9	0.0844845629379
10	0.0730218976636	10	0.0670782548305
12	0.0496719736495	12	0.0454265058162
15	0.0324354961416	15	0.0292089284626
20	0.0185529147914	20	0.016217879749
25	0.012225766438	25	0.0106719512487
30	0.00893901339010	30	0.03775322589964
35	0.00717868328653	35	0.00602024265453
40	0.00590176400259	40	0.00446053012128
45	0.00503529093798	45	0.00271833167304
50	0.00445903851161	50	0.00132270731466



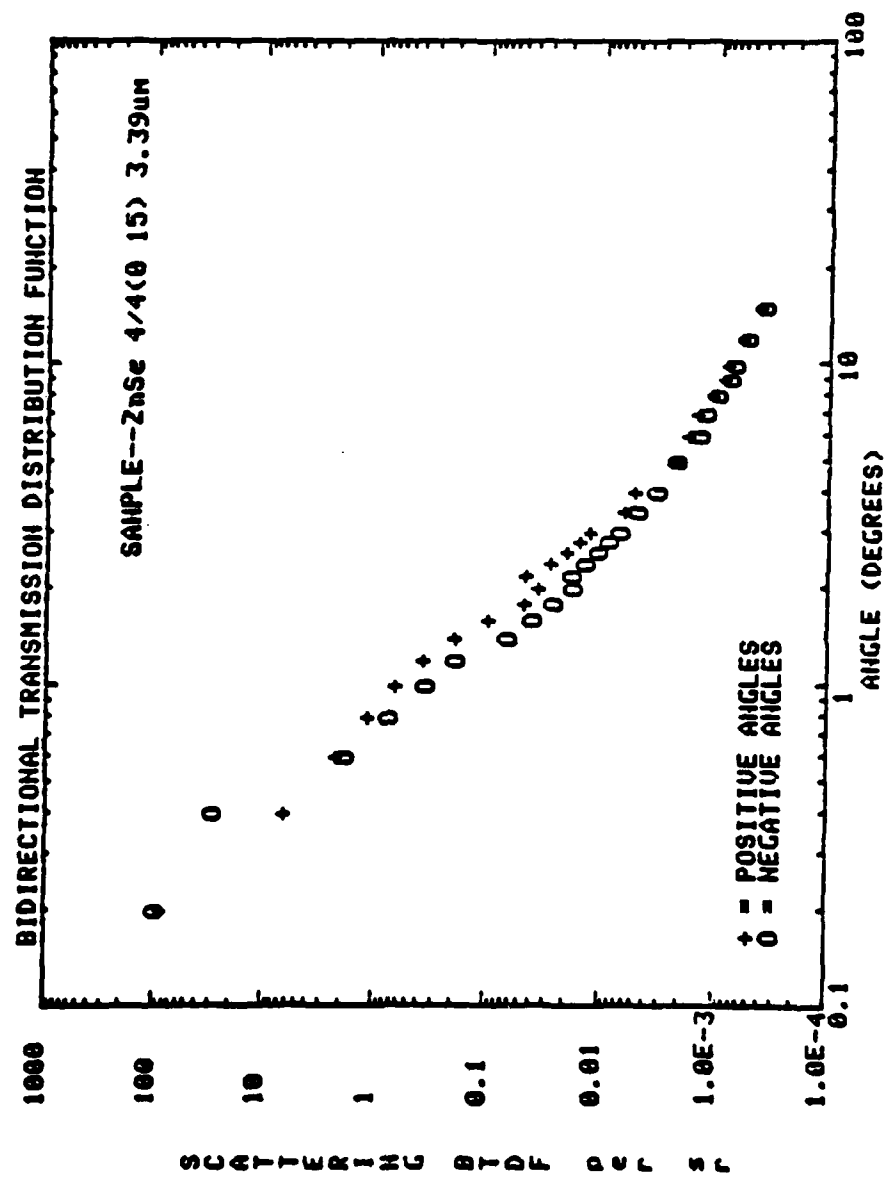
SAMPLE--ZnSe 4/4(15 30) 0.6328um

SAMPLE-ZNSE, 1.6328, (15, 30)		BTDF DATA	
ANGLE		BTDF DATA	
0	07064.6766169	0	88323.3532934
0.2	28.1923715283	-0.2	31.896207644
0.4	13.6451078957	-0.4	17.5316035899
0.6	10.3747928764	-0.6	12.4963336868
0.8	8.6268659278	-0.8	10.0399803372
1	5.43267023547	-1	6.91084529735
1.2	4.23233859122	-1.2	5.33948804802
1.4	3.32039831189	-1.4	4.06520329715
1.6	2.45522417221	-1.6	3.02544946114
1.8	2.01873993862	-1.8	2.53293451249
2	1.65799367605	-2	1.89970095136
2.2	1.35621921002	-2.2	1.52445144613
2.4	1.1691545113	-2.4	1.26646740432
2.6	0.98339168646	-2.6	1.10778477858
2.8	0.825870947172	-2.8	0.896540578939
3	0.781094853519	-3	0.81670027449
3.5	0.436982006236	-3.5	0.503326966039
4	0.324212512647	-4	0.356287689634
5	0.206650322612	-5	0.223386819319
6	0.141525941193	-6	0.149584414847
7	0.103748162892	-7	0.107169238981
8	0.0870317675476	-8	0.0902730558088
9	0.068776377869	-9	0.0702597450786
10	0.0560460609977	-10	0.6562078456114
12	0.0394820508496	-12	0.0383236093335
15	0.0267040930276	-15	0.0251233494231
20	0.0158782382083	-20	0.0143502330491
25	0.0107412733252	-25	0.00725456029014
30	0.00830963387597	-30	0.00333380281093
35	0.00668611797844	-35	0.00369321582977
40	0.00559162569395	-40	0.0022049643092
45	0.00495286057066	-45	0.00109793173755
50	0.00432380460103	-50	



SAMPLE--ZnSe 4/4(0 0) 3.39um

ANGLE	BTDF DATA	ANGLE	BTDF DATA
0	95914.496935	0	102169.790213
0.2	93.71225852	-0.2	96.3897519621
0.4	7.53044937204	-0.4	34.3053804726
0.6	1.92444817285	-0.6	1.92444817285
0.8	0.920388256582	-0.8	0.819982264953
1	0.711209107359	-1	0.343053804726
1.2	0.376522468602	-1.2	0.30958514085
1.4	0.217546315192	-1.4	0.070284194139
1.6	0.0920388256582	-1.6	0.0451826962322
1.8	0.056060119918	-1.8	0.0276116476975
2	0.0460194128291	-2	0.0225913481161
2.2	0.0442623079756	-2.2	0.0192444817285
2.4	0.02694227442	-2.4	0.0136635820273
2.6	0.0192444817285	-2.6	0.0111617994026
2.8	0.0165502542865	-2.8	0.00904490641241
3	0.0136635820273	-3	0.0078902375087
3.5	0.00712045823956	-3.5	0.00481112043213
4	0.00481112043213	-4	0.00365645152842
5	0.00230933780742	-5	0.00211689299014
6	0.00165502542865	-6	0.00157804750174
7	0.00138560268445	-7	0.001347113721
8	0.00115466890371	-8	0.00100071304988
9	9.622240864E-4	-9	9.044906412E-4
10	7.505347874E-4	-10	6.543123788E-4
12	6.543123788E-4	-12	5.380454684E-4
15	4.426230798E-4	-15	3.271561894E-4



SAMPLE--ZnSe 4/4(0 15) 3.39um

ANGLE  
0  
-0.2  
-0.4  
-0.6  
-0.8  
-1  
-1.2  
-1.4  
-1.6  
-1.8  
-2  
-2.2  
-2.4  
-2.6  
-2.8  
-3  
-3.5  
-4  
-5  
-6  
-7  
-8  
-9  
-10  
-12  
-15

BTDF DATA

81318.8126188  
91.0347657419  
27.6116476975  
1.75710485348  
0.719576273328  
0.334606538757  
0.184077651316  
0.062753744767  
0.0376522468602  
0.0251014979068  
0.0167343319379  
0.0173200335557  
0.0130862475754  
0.0101955753161  
0.00827512714327  
0.0065431237877  
0.00461867561485  
0.00307911707657  
0.00211689299014  
0.001347113721  
0.00117391338544  
9.622240364E-4  
7.505347874E-4  
6.735568605E-4  
5.196010067E-4  
3.656451528E-4

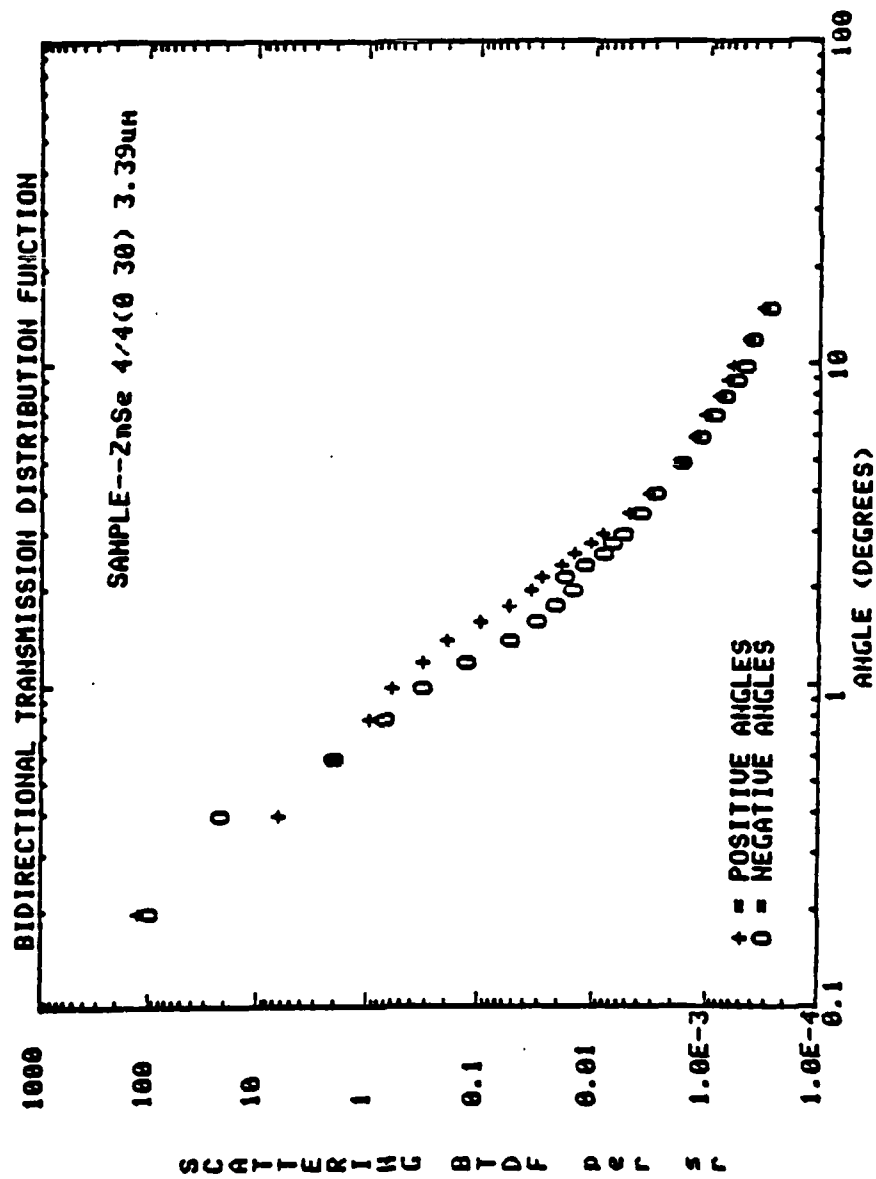
ANGLE

0  
0.2  
0.4  
0.6  
0.8  
1  
1.2  
1.4  
1.6  
1.8  
2  
2.2  
2.4  
2.6  
2.8  
3  
3.5  
4  
5  
6  
7  
8  
9  
10  
12  
15

BTDF DATA

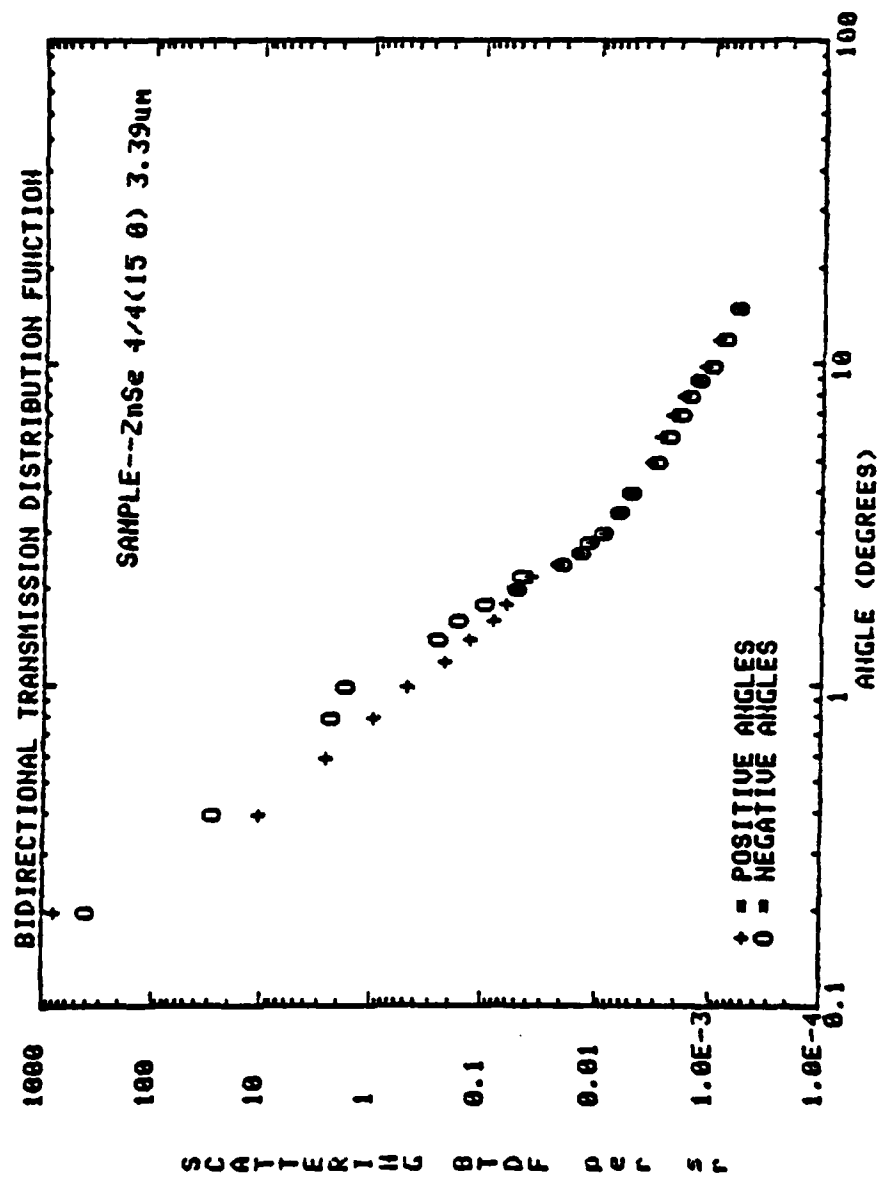
81318.8126188  
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2.09179149223  
1.08773157596  
0.619170281701  
0.351420970695  
0.184077651316  
0.0920388256582  
0.0451825962322  
0.0343053804726  
0.0442623079756  
0.02694227442  
0.0192444817285  
0.0150106957483  
0.0119315786717  
0.00596578933585  
0.00481112043213  
0.00211689299014  
0.00167426991038  
0.00138560268445  
0.00103920201334  
0.275127143E-4  
7.890237509E-4  
5.773344519E-4  
4.041341163E-4





SAMPLE--ZnSe 4/4(0 30) 3.39um

ANGLE	BTDF DATA	ANGLE	BTDF DATA
0	03403.9103783	0	79233.7148594
0.2	117.809696843	-0.2	93.712258852
0.4	6.19170281701	-0.4	20.9179149223
0.6	1.84077651316	-0.6	1.92444817285
0.8	0.920388256582	-0.8	0.669373277514
1	0.577334451856	-1	0.70558514085
1.2	0.30958514085	-1.2	0.125507489534
1.4	0.184077651316	-1.4	0.0502029558136
1.6	0.0920388256582	-1.6	0.0292850808913
1.8	0.0518764290074	-1.8	0.0200811963254
2	0.0334686638757	-2	0.0142241821472
2.2	0.02694227442	-2.2	0.0167426991038
2.4	0.0178973680075	-2.4	0.0111617994026
2.6	0.0138560268445	-2.6	0.00769779269141
2.8	0.0100071304988	-2.8	0.00635067897042
3	0.0078902375087	-3	0.0051960100667
3.5	0.00461867561485	-3.5	0.00365645152842
4	0.00307911707657	-4	0.002694227442
5	0.00163578094693	-5	0.0016165364652
6	0.00123164683063	-6	0.00111617994026
7	0.00100071304988	-7	8.275127143E-4
8	7.697792691E-4	-8	6.735568605E-4
9	6.35067897E-4	-9	5.388454834E-4
10	5.773344519E-4	-10	4.426230798E-4
12	4.23378598E-4	-12	3.048896346E-4
15	3.079117077E-4	-15	2.694227442E-4



SAMPLE--2nSz 4/4(15 0) 3.39um

ANGLE  
0  
0.2  
0.4  
0.6  
0.8  
1  
1.2  
1.4  
1.6  
1.8  
2  
2.2  
2.4  
2.6  
2.8  
3  
3.5  
4  
5  
6  
7  
8  
9  
10  
12  
15

BTDF DATA

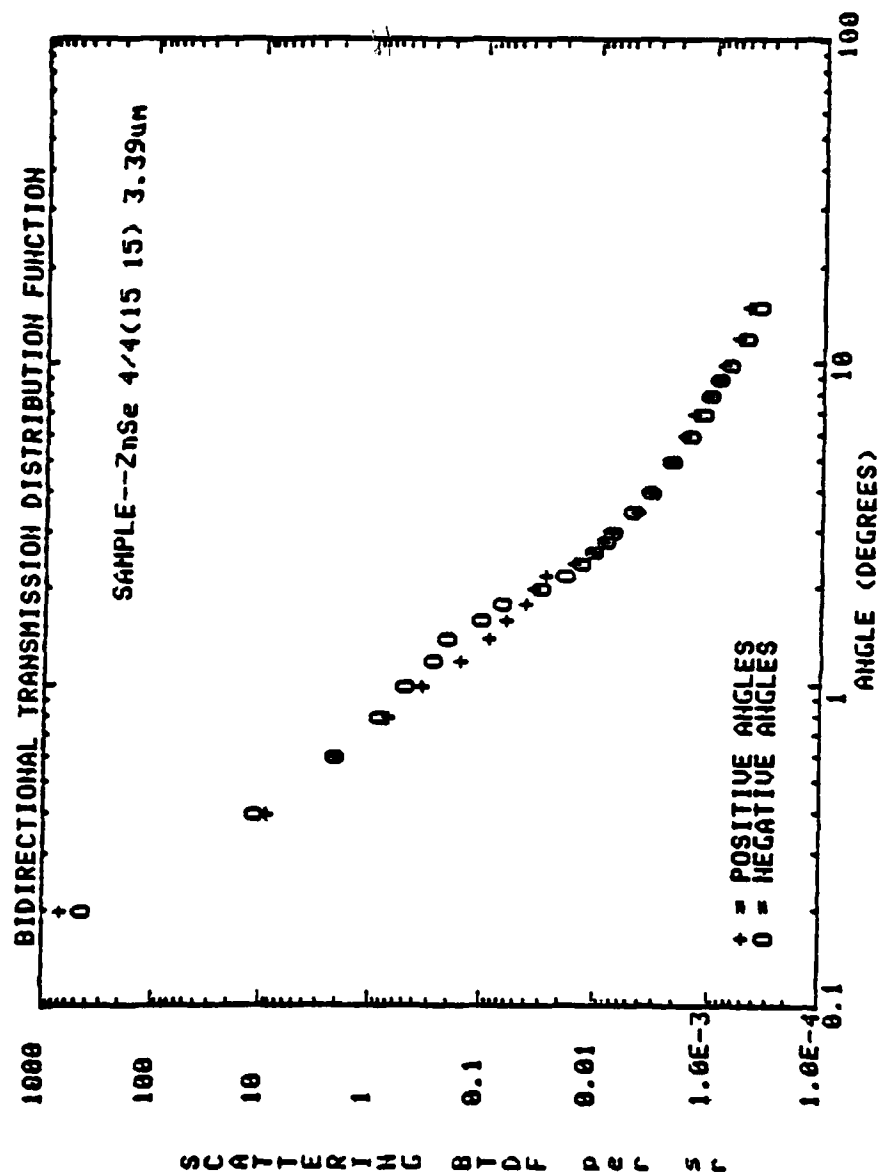
104254.887973  
729.198514132  
10.0405991627  
2.51014979068  
0.920388256582  
0.451826962322  
0.209179149223  
0.125507489534  
0.0769779269141  
0.0602435949763  
0.0485295626198  
0.0365645152842  
0.0211689299014  
0.0138560268445  
0.0103920201334  
0.00808268232599  
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5.773344519E-4

ANGLE

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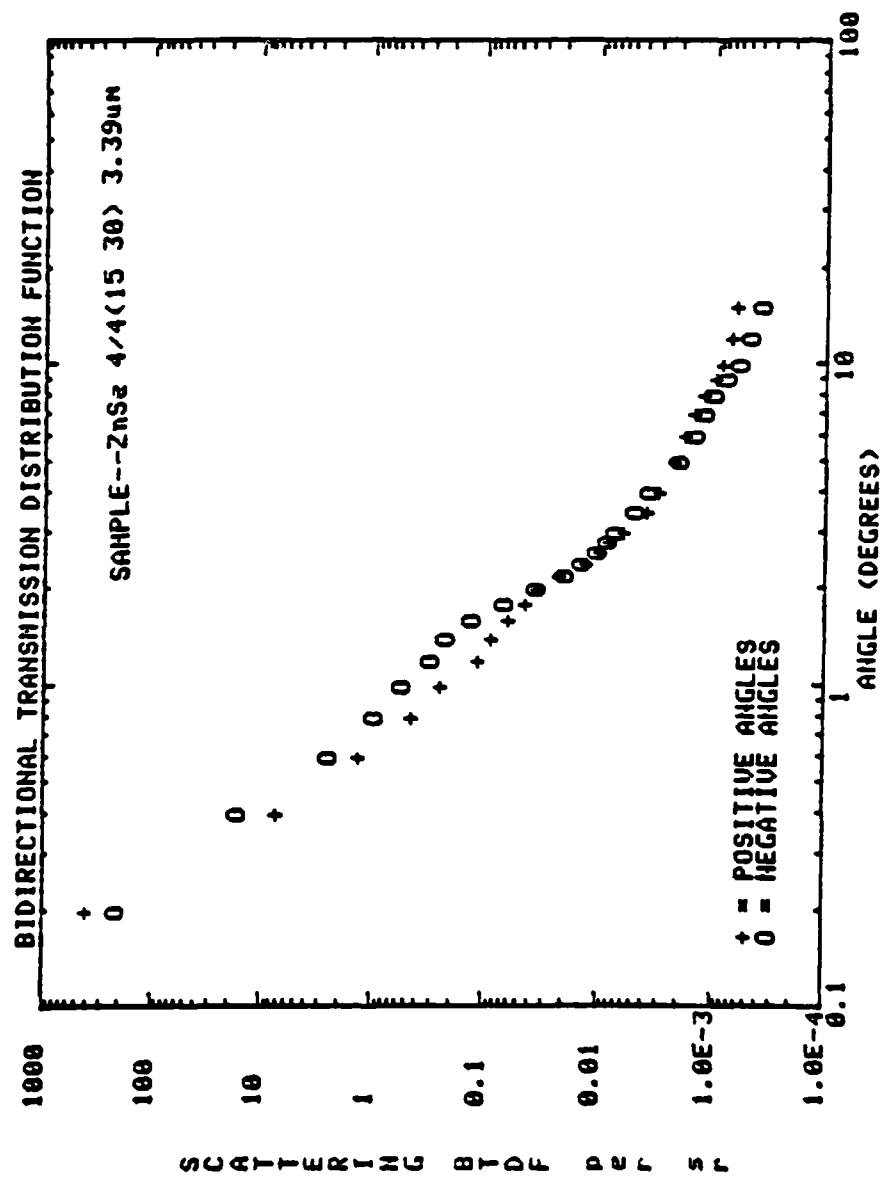
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0.00150166957483  
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SAMPLE--ZnSe 4/4(15 15) 3.39um

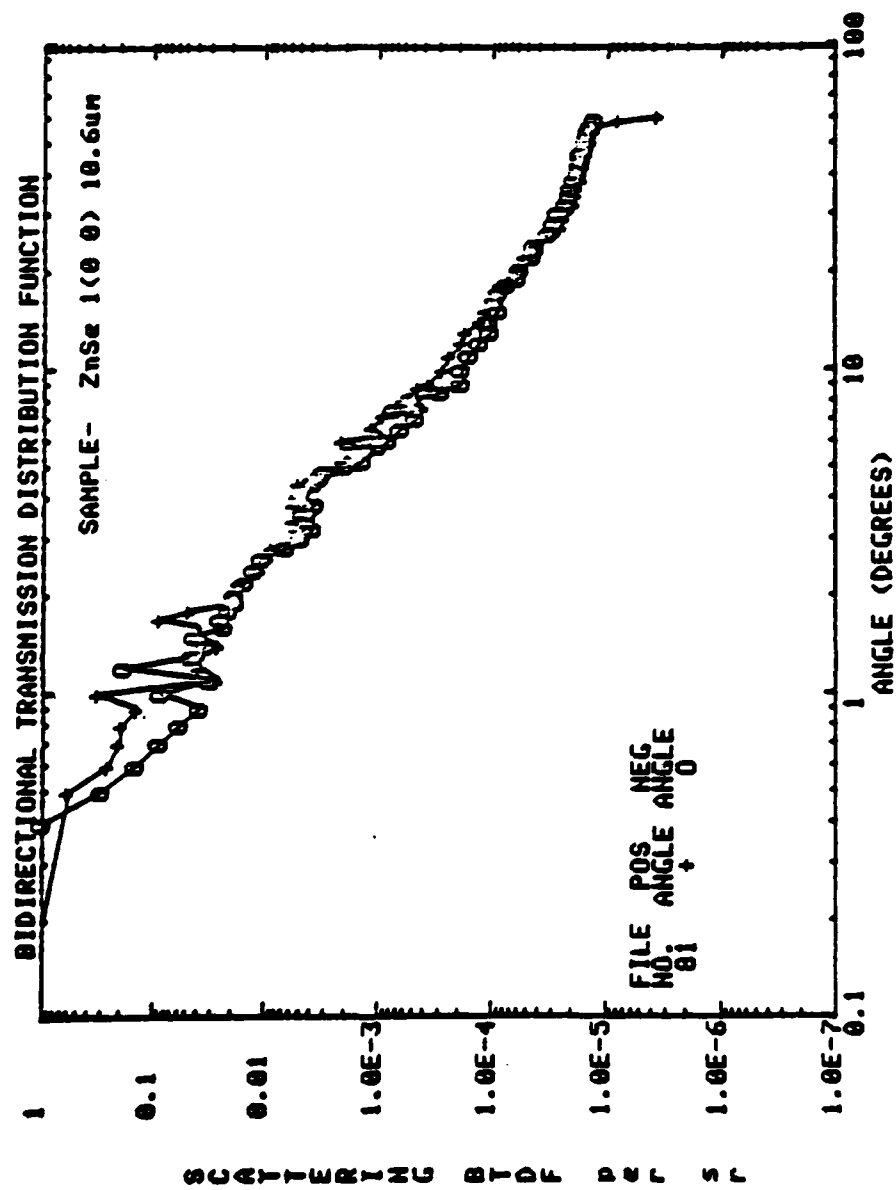
ANGLE	BTDF DATA	ANGLE	BTDF DATA
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0.4	8.36716596893	-0.4	10.8773157596
0.6	1.92444817285	-0.6	2.00811983254
0.8	0.669373277514	-0.8	0.803247933017
1	0.326319472788	-1	0.46856129426
1.2	0.150608987441	-1.2	0.267749311006
1.4	0.0836716596893	-1.4	0.200811983254
1.6	0.0602435949763	-1.6	0.100405991627
1.8	0.0401623966509	-1.8	0.0652638945576
2	0.0343053804726	-2	0.0292850808913
2.2	0.02694227442	-2.2	0.0180898128248
2.4	0.0150106957483	-2.4	0.0128938027581
2.6	0.0100071304988	-2.6	0.0100071304988
2.8	0.00827512714327	-2.8	0.0078902375087
3	0.00692801342227	-3	0.00692801342227
3.5	0.00423378598028	-3.5	0.00461867561485
4	0.00307911707657	-4	0.00327156189385
5	0.00211689299014	-5	0.00211689299014
6	0.00169351439211	-6	0.00150106957483
7	0.00138560268445	-7	0.0011546890371
8	0.00105846495507	-8	0.00100071304988
9	0.275127143E-4	-9	8.275127143E-4
10	7.697792691E-4	-10	6.735568605E-4
12	5.773344519E-4	-12	4.811120432E-4
15	4.618675615E-4	-15	3.656451528E-4



SAMPLE--ZnSe 4/4(15 30) 3.39um

ANGLE	BTDF DATA	ANGLE	BTDF DATA
0	104254.087973	0	104254.087973
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0.6	1.25507489534	-0.6	2.3428064713
0.8	0.426725464415	-0.8	0.920388256582
1	0.23428064713	-1	6.518764290074
1.2	0.108773157596	-1.2	0.292850808913
1.4	0.0836716596893	-1.4	0.217546315192
1.6	0.0602435949763	-1.6	0.125507489534
1.8	0.0418358298446	-1.8	0.0652638945576
2	0.0326319472788	-2	0.0343053804726
2.2	0.0211689299014	-2.2	0.0192444817285
2.4	0.0123164683063	-2.4	0.01347113721
2.6	0.0092373512297	-2.6	0.0100071304988
2.8	0.00769779269141	-2.8	0.00808268232599
3	0.00577334451856	-3	0.00692801342227
3.5	0.00365645152842	-3.5	0.00461867561485
4	0.00288667225928	-4	0.00346400671114
5	0.00211689299014	-5	0.00192444817285
6	0.00159351439211	-6	0.00138560260445
7	0.00140484716618	-7	0.00115466890371
8	0.00115466890371	-8	9.622240864E-4
9	9.23735123E-4	-9	7.505347874E-4
10	8.082682326E-4	-10	5.773344519E-4
12	6.735568605E-4	-12	4.618675615E-4
15	6.158234153E-4	-15	3.656451528E-4





SAMPLE - ZnSe 1(0 0) 10.6um

ANGLE  
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0.00913035619  
0.00853433256  
0.00485729141  
0.00520676933  
0.00560222051  
0.00389144827  
0.00547528640

ANGLE  
4 4.2 4.4 4.6 4.8 5 5.2 5.4 5.6 5.8 6 6.2 6.6 7.2 7.6 8 8.4 8.8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

BTDF DATA  
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ANGLE

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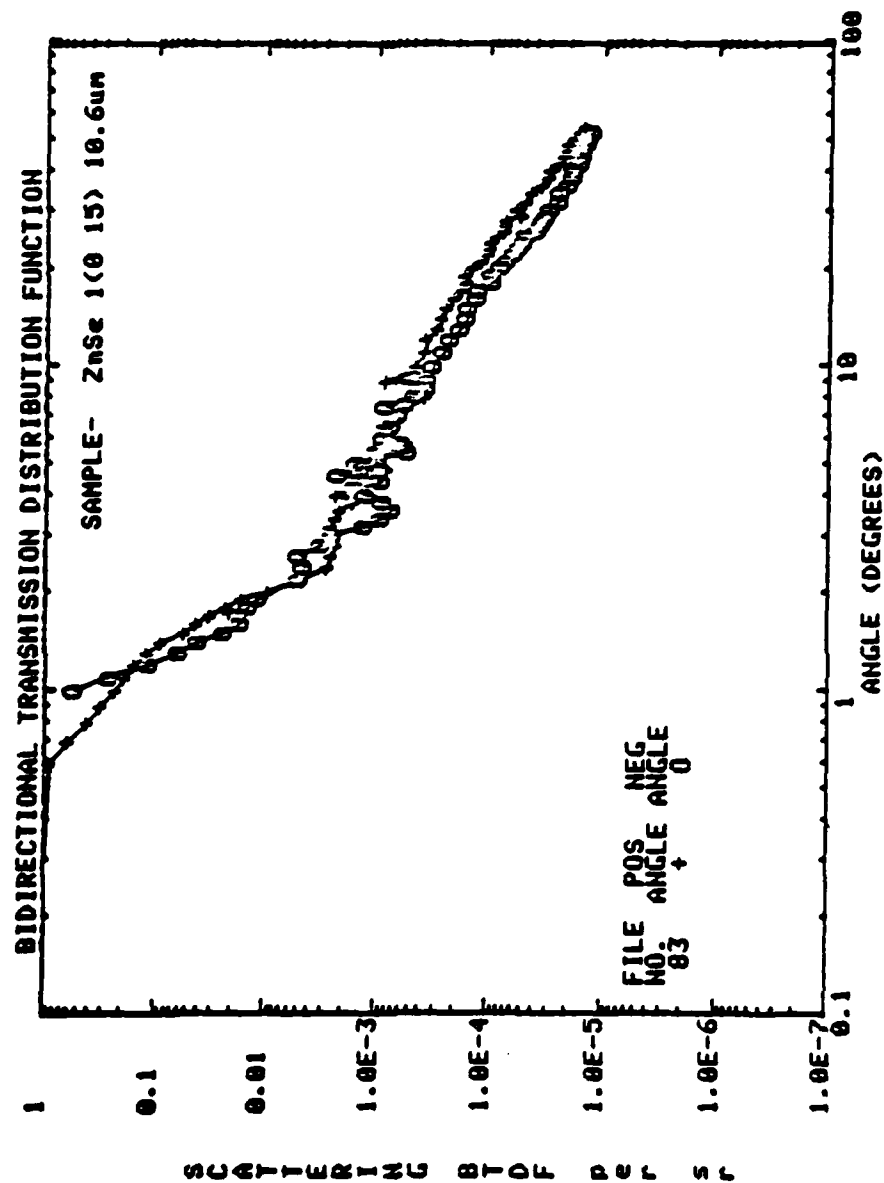
ZnSe 1(0 0) 10.6  $\mu$ m

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0.00299680307199



SAMPLE - ZnSe 1(0 15) 10.6um

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1.6  
1.7  
1.8  
1.9  
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3.2  
3.4  
3.6  
3.8

BTDF DATA  
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ANGLE  
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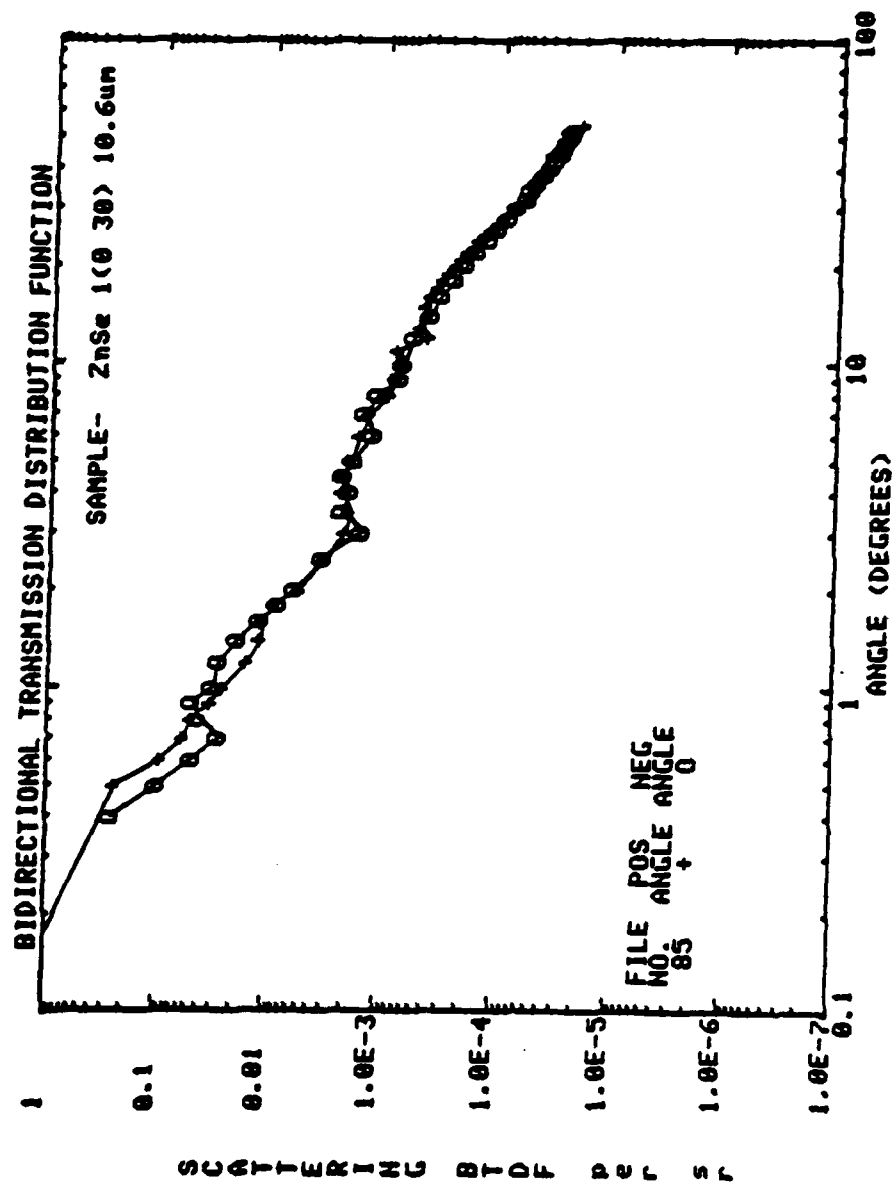
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SAMPLE - ZnSe 1(0 30) 10.6um

ANGLE

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0.3  
0.4  
0.5  
0.6  
0.7  
0.8  
0.9  
1  
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BTDF DATA

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ANGLE

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BTDF DATA

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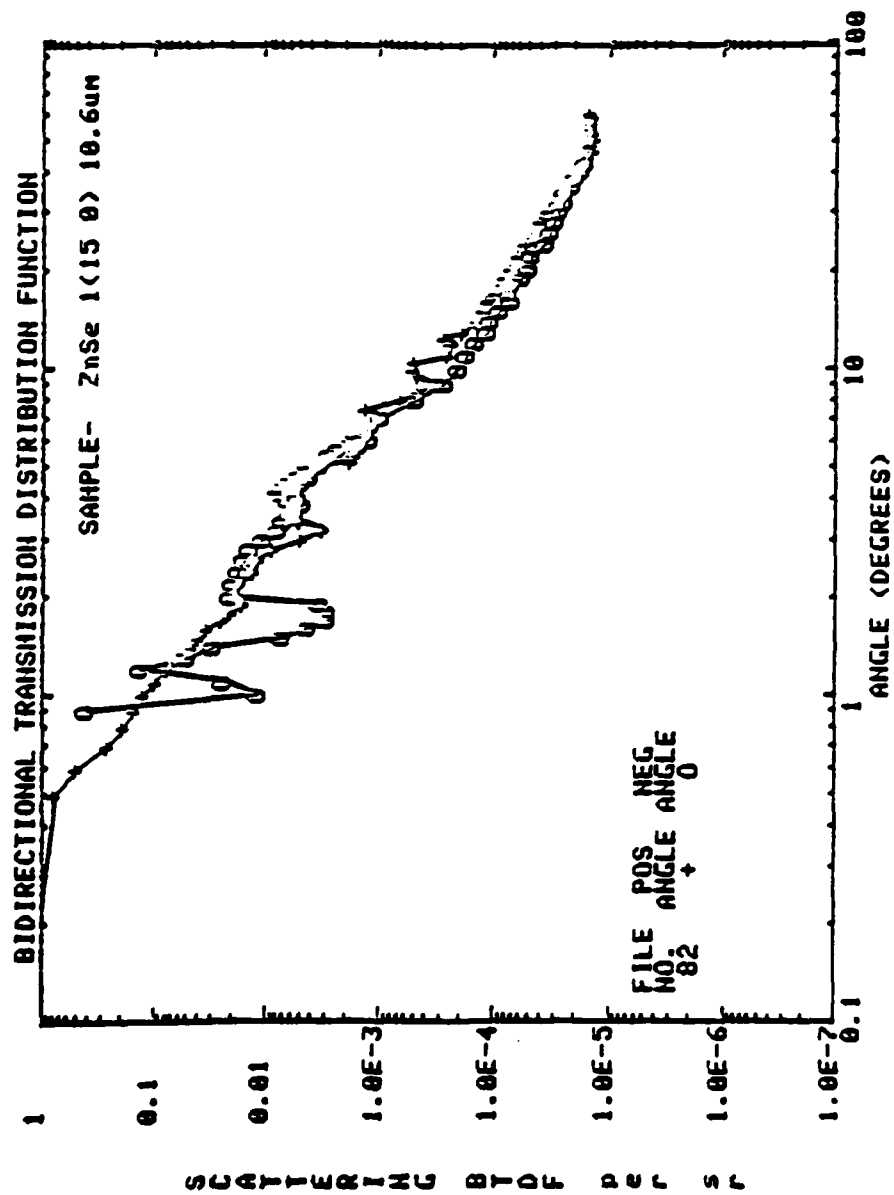
ZuSe 1(0 30) 10.6 um

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-2.5  
-2  
-1.8  
-1.6  
-1.4

BTDF DATA  
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3.152442421E-5  
3.559832154E-5  
3.925347278E-5  
4.371033641E-5  
4.989833215E-5  
5.611001903E-5  
6.226819924E-5  
7.771454147E-5  
9.171169224E-5  
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1.678717558E-4  
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2.517667688E-4  
3.394490649E-4  
4.034064168E-4  
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6.775273532E-4  
7.441856425E-4  
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0.001447349297  
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0.001780344327  
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0.001912640411  
0.002179873023  
0.001471760482  
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0.018253211167

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-0.5  
-0.4  
-0.3  
-0.2  
-0.1  
0

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0.0456221372691  
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24002.6515028



SAMPLE - ZnSe 1(15 0) 10.6um

ANGLE  
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2 2.2 2.4 2.6 2.8 3 3.2 3.4 3.6 3.8

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0.0064712364  
0.0061014178

ANGLE  
4 4.2 4.4 4.6 4.8 5 5.2 5.4 5.6 5.8 6 6.5 7 7.5 8 8.5 9 9.5 10 10.5 11 12 12.5 13 14 15 16 17 18 19 20 21 22

BTDF DATA  
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4.519625487E-4  
3.304385013E-4  
4.502541816E-4  
4.881722571E-4  
4.82110509E-4  
2.460188778E-4  
2.25025941E-4  
2.699417767E-4  
1.819331351E-4  
1.388972005E-4  
1.226886237E-4  
1.127169787E-4  
9.239510937E-5  
8.203283204E-5  
7.824927674E-5  
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6.193079143E-5  
6.112534928E-5

ZnSe 1(15 0) 10.6  $\mu$ m

ANGLE  
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-14  
-13  
-12  
-11  
-10  
-9  
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-4.6  
-4.4  
-4.2  
-4  
-3.8  
-3.6  
-3.4  
-3.2  
-3  
-2.8

BTDF DATA  
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6.983936676E-5  
8.786663373E-5  
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1.119964073E-4  
1.423021576E-4  
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0.001491892787  
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0.003100955369  
0.003310072225  
0.004097719324  
0.004144505869  
0.004930525417  
0.005249489194  
0.005249489194  
0.004745817796  
0.00552166607  
0.006858549997  
0.007613242272  
0.010399705433  
0.013268757326

ANGLE  
23  
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-30  
-28  
-26

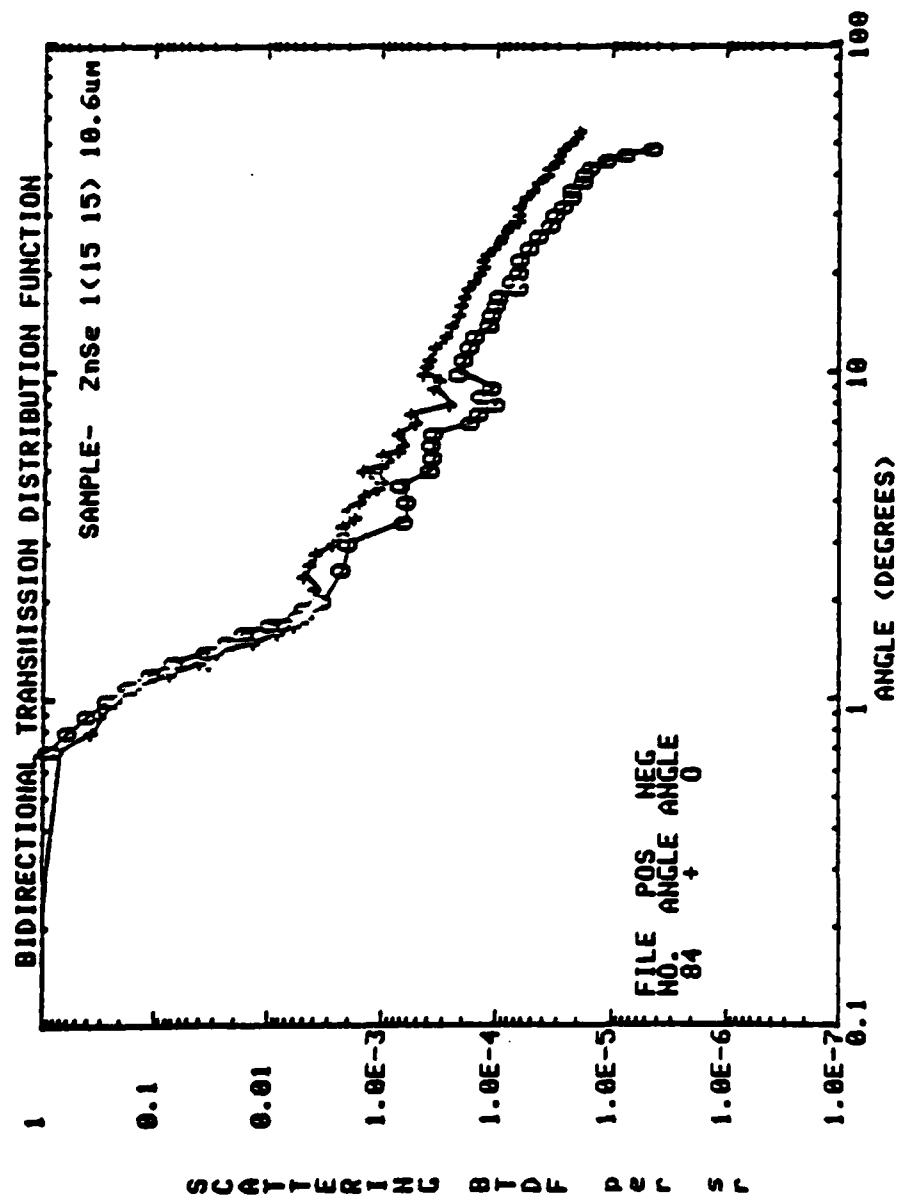
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2.013515725E-5  
1.897083408E-5  
1.691056076E-5  
1.525063031E-5  
1.412654223E-5  
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1.41516249E-5  
1.380509093E-5  
1.445589151E-5  
1.411787979E-5  
1.638202944E-5  
1.747191604E-5  
1.956025066E-5  
2.098577724E-5  
2.411760039E-5  
2.450201686E-5  
2.679900305E-5  
2.981611054E-5  
3.233764837E-5

ZnSe 1(15 0) 10.6  $\mu$ m

BTDF DATA

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 0.0189714643021  
 0.0199942651196  
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 0.00287084194557  
 0.00283341240874  
 0.00421001758392  
 0.00713967504516  
 0.0281630186918  
 0.0483476698098  
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 0.0229723478245  
 0.0113879213972  
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 4778.09836354  
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ANGLE  
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 -1.7  
 -1.6  
 -1.5  
 -1.4  
 -1.3  
 -1.2  
 -1.1  
 -1  
 -0.9  
 -0.8  
 -0.7  
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 -0.3  
 -0.2  
 -0.1  
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SAMPLE - ZnSe 1(15 15) 10.6um

ANGLE  
0  
0.1  
0.2  
0.3  
0.4  
0.5  
0.6  
0.7  
0.8  
0.9  
1  
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1.2  
1.3  
1.4  
1.5  
1.6  
1.7  
1.8  
1.9  
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2.2  
2.4  
2.6  
2.8  
3  
3.2  
3.4  
3.6  
3.8

BTDF DATA  
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0.02623668289  
0.01267063634  
0.00781287883  
0.00558544526  
0.00427667274  
0.00397494872  
0.00365015167  
0.00374093527  
0.00466004036  
0.00413024849  
0.00366222129  
0.00257299723  
0.00206698017  
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0.00166267796  
0.00106589823

ANGLE  
4  
4.2  
4.4  
4.6  
4.8  
5  
5.2  
5.4  
5.6  
5.8  
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6.5  
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24

BTDF DATA  
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0.00142165435251  
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6.733781243E-4  
6.306043062E-4  
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3.021690215E-4  
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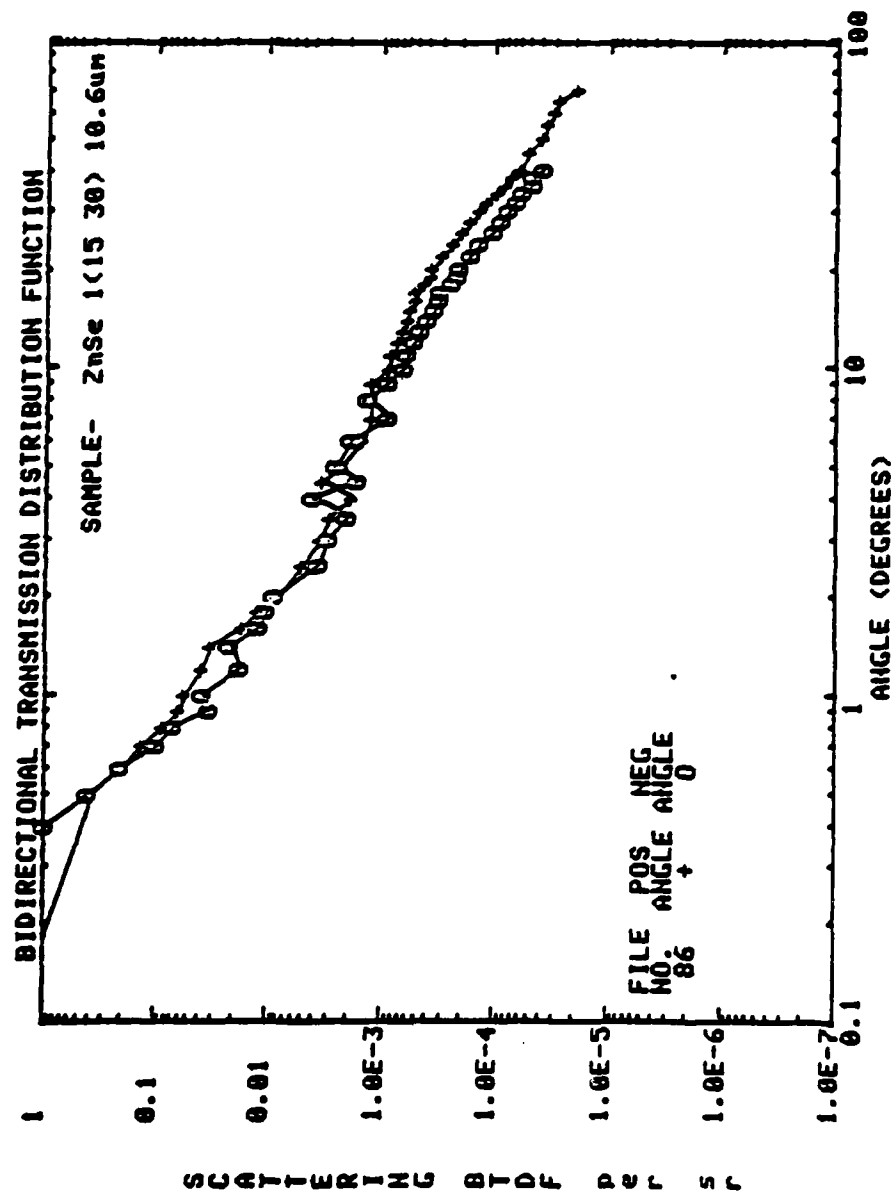
ZnSe 1 (15 15) 10.6  $\mu$ m

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36  
34  
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28  
26  
24  
22

BTDF DATA  
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ANGLE  
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-1.4  
-1.3

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1.057369265E-4  
1.317473582E-4  
1.001283089E-4  
1.401689329E-4  
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3.43860911E-4  
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3.491129579E-4  
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0.0154686836571  
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0.0647020641336



SAMPLE -- ZnSe 1(15 30) 10.6um

ANGLE  
0 1  
0.2 3  
0.3 4  
0.4 5  
0.5 6  
0.6 7  
0.7 8  
0.8 9  
0.9 1  
1 2  
1.2 3  
1.4 4  
1.6 5  
1.8 6  
2 7  
2.5 8  
3 9  
3.5 10  
4 11  
4.5 12  
5 13  
6  
7  
8  
9  
10  
11  
12  
13

BTDF DATA  
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0.015739243  
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0.004053080  
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0.001238403  
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7.20081719E  
6.425844364

ANGLE  
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BTDF DATA  
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3.45001570E-5  
2.996477016E-5  
2.7154195E-5  
1.89110442E-5  
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ZnSe 1" (15 30) 10.6  $\mu$ m

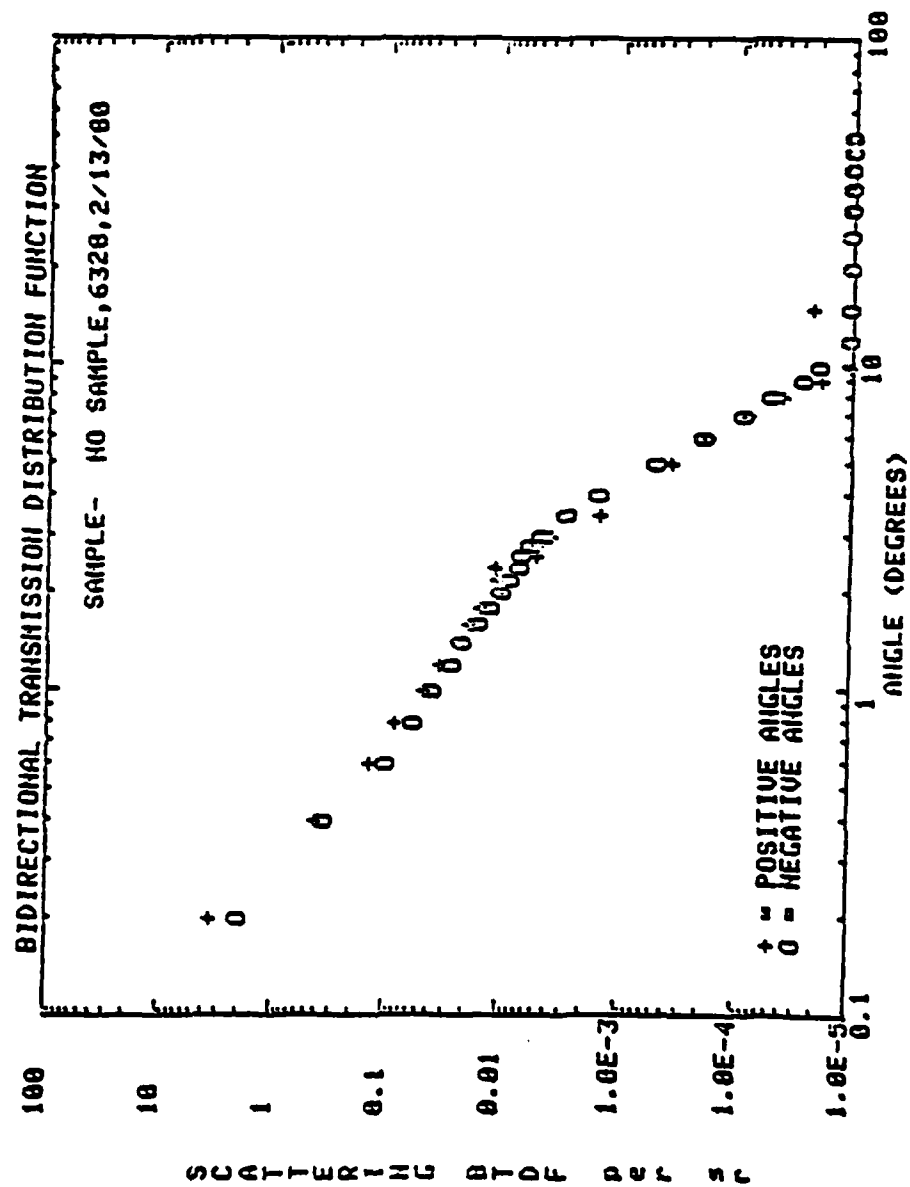
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-10  
-9  
-8  
-7  
-6  
-5  
-4.5  
-4  
-3.5  
-3  
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-2  
-1.8  
-1.6  
-1.4  
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-0.7  
-0.6  
-0.5

BTDF DATA

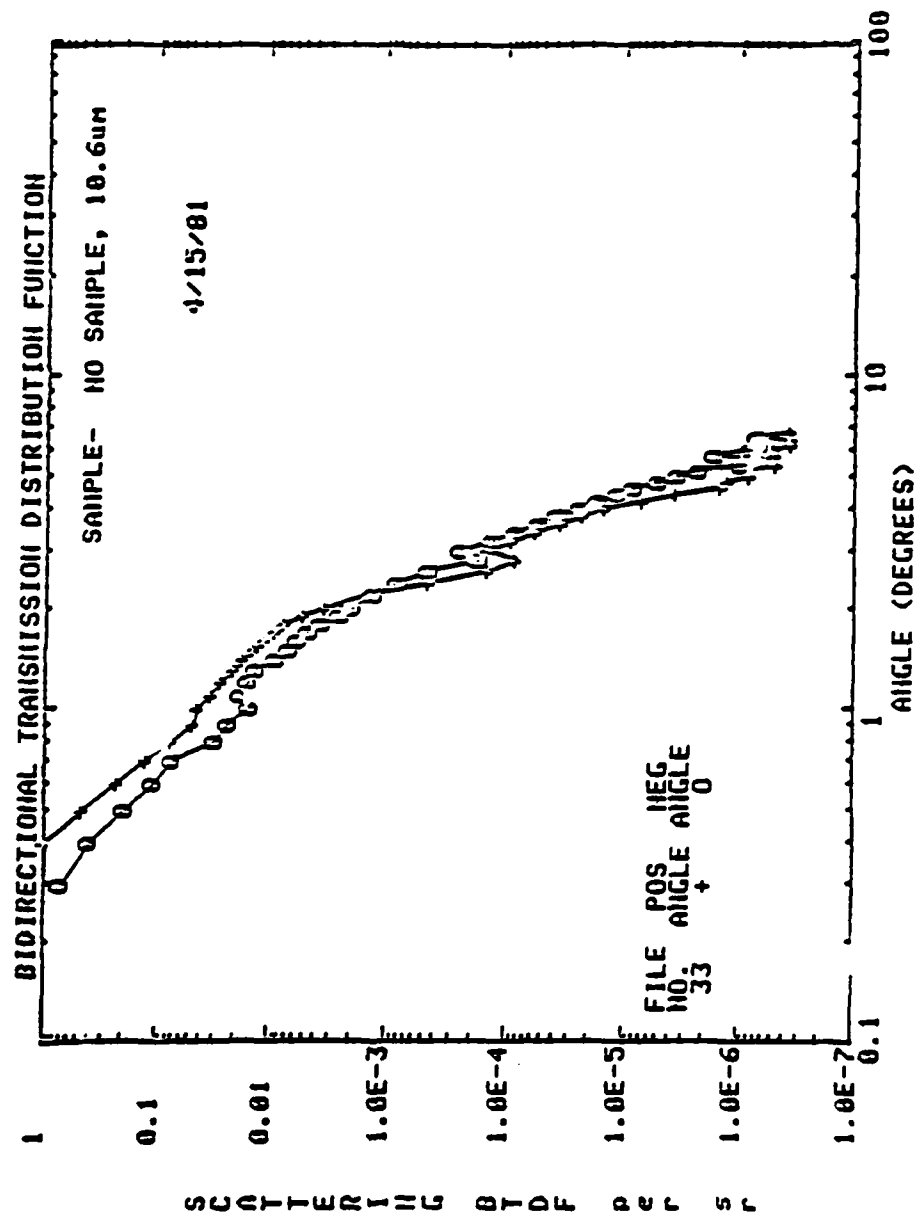
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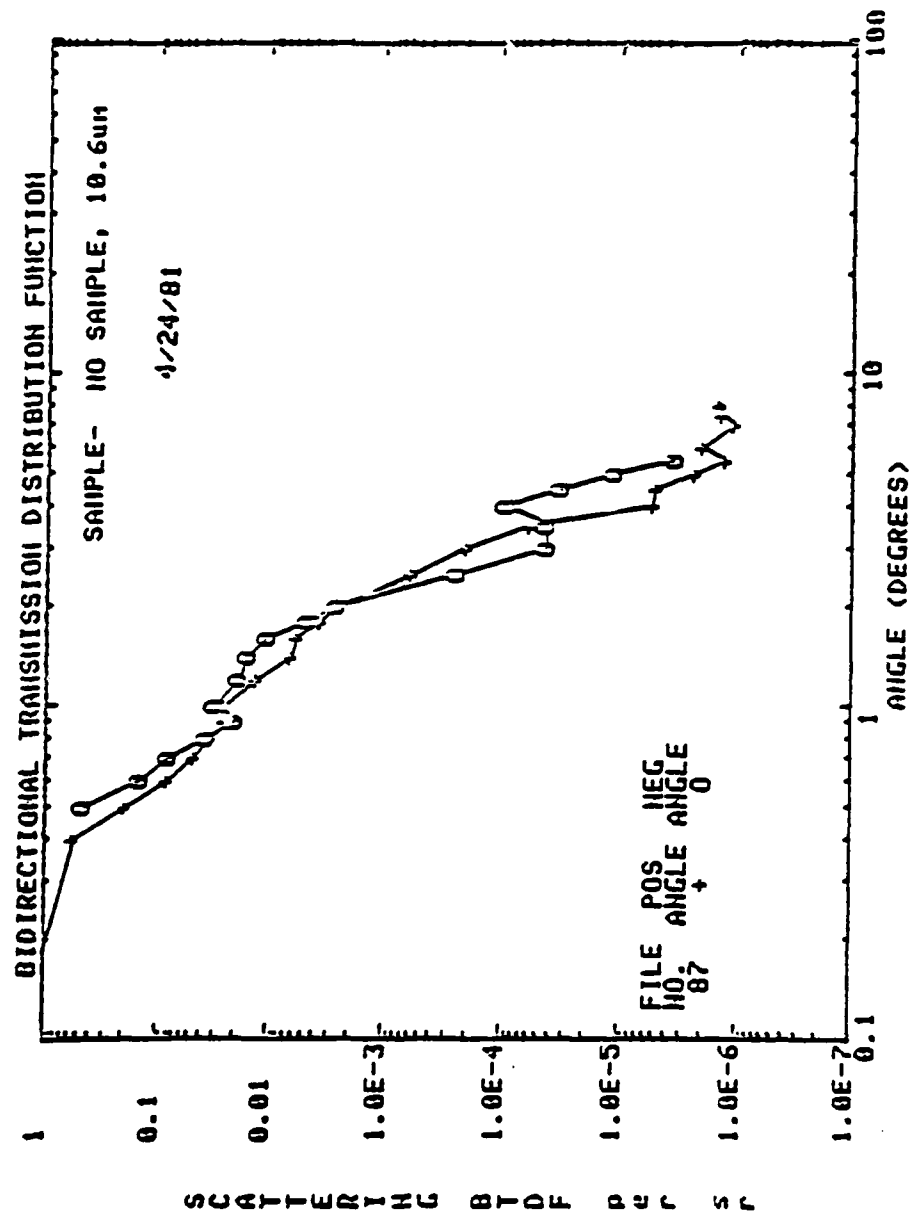
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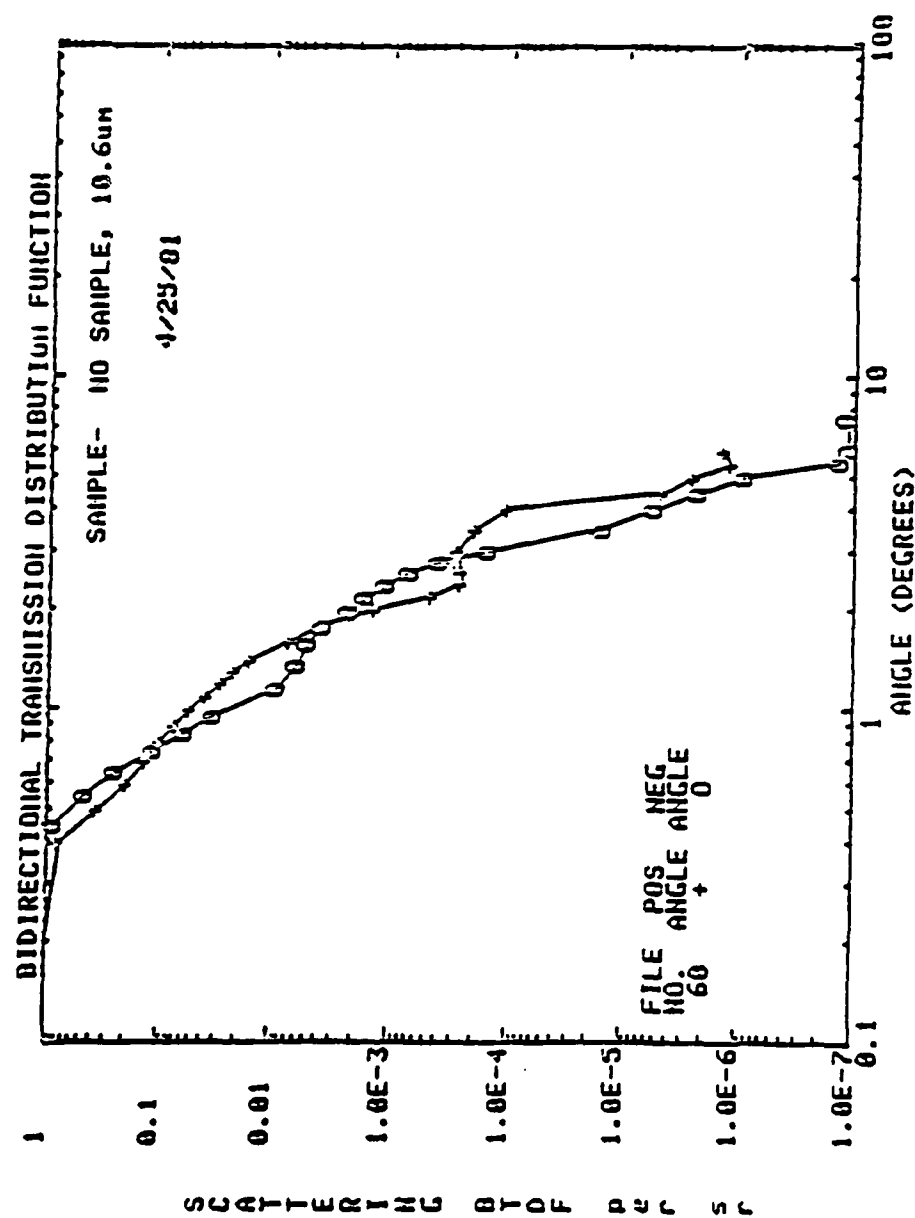


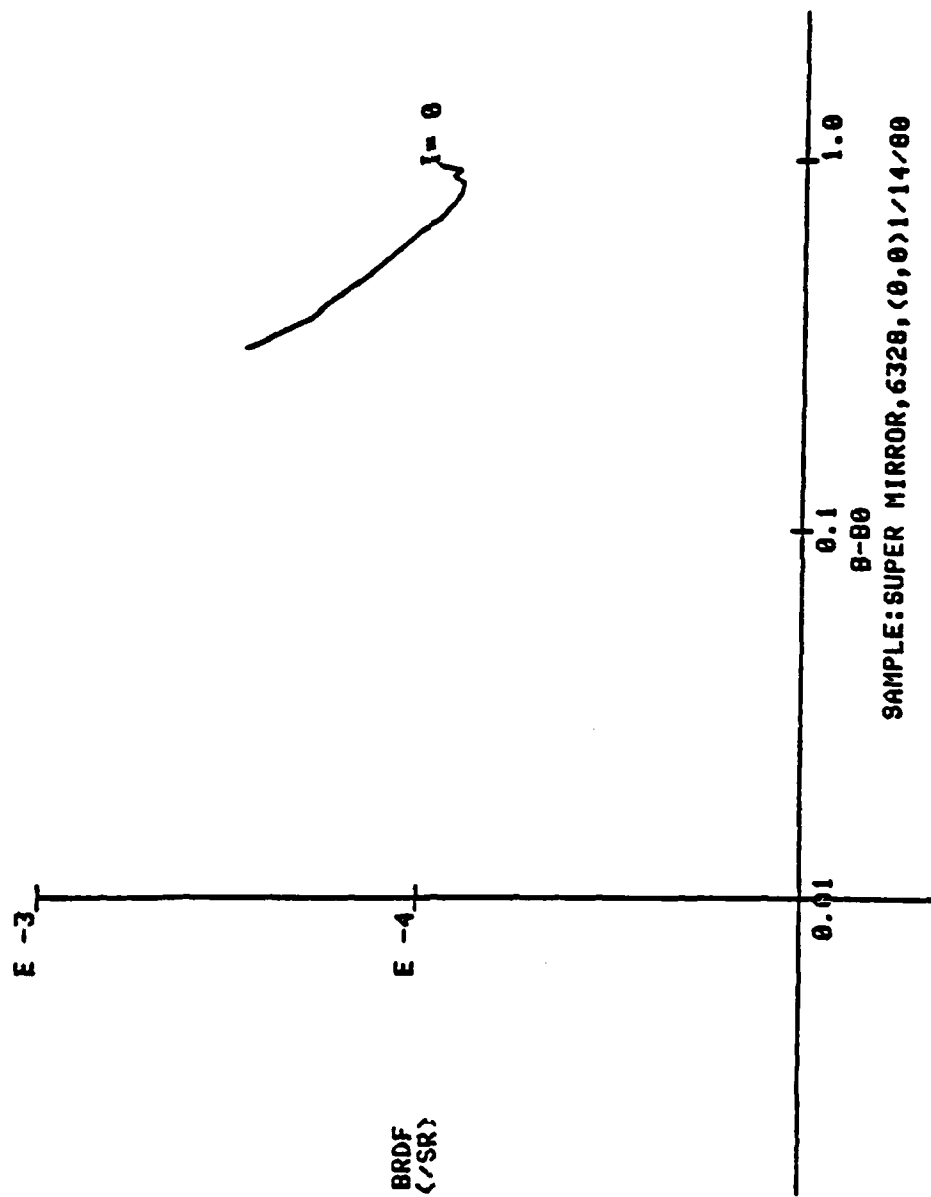






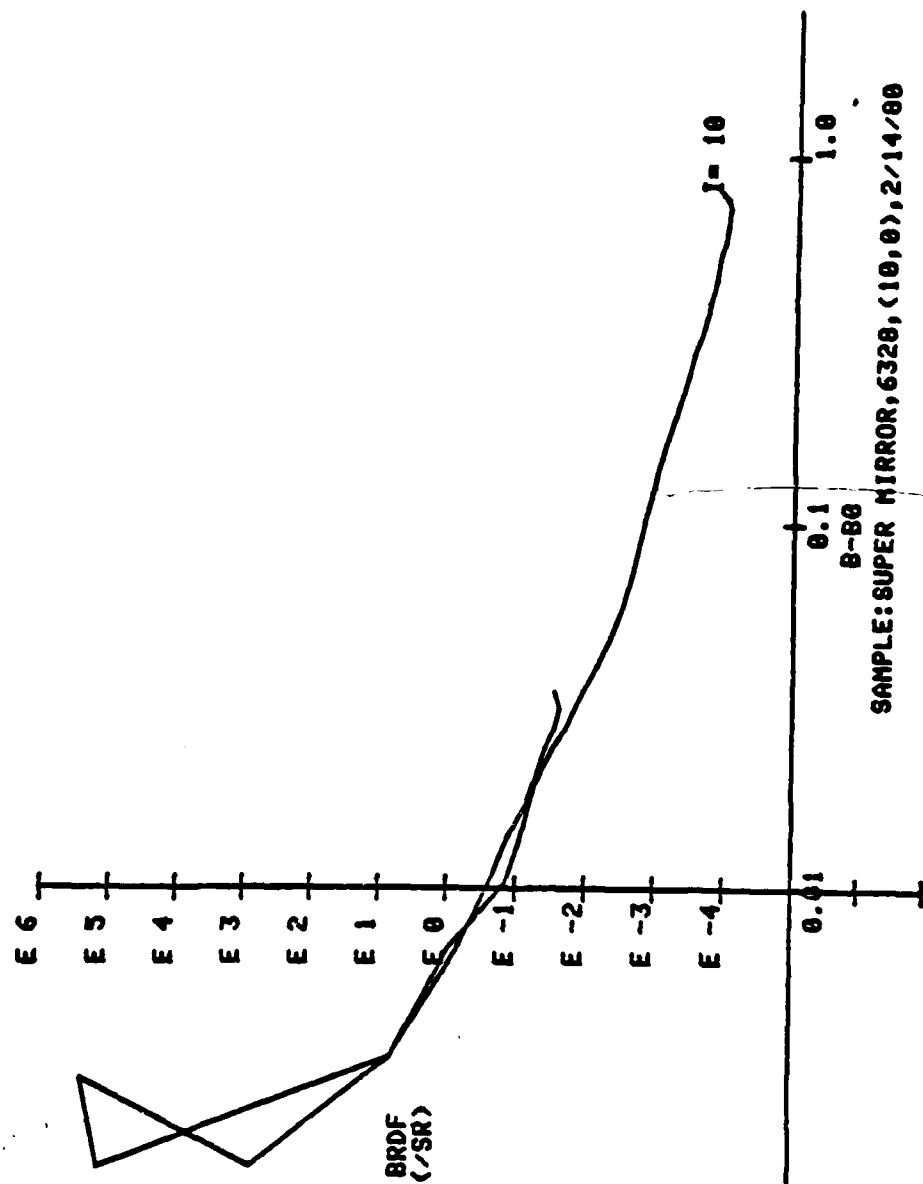






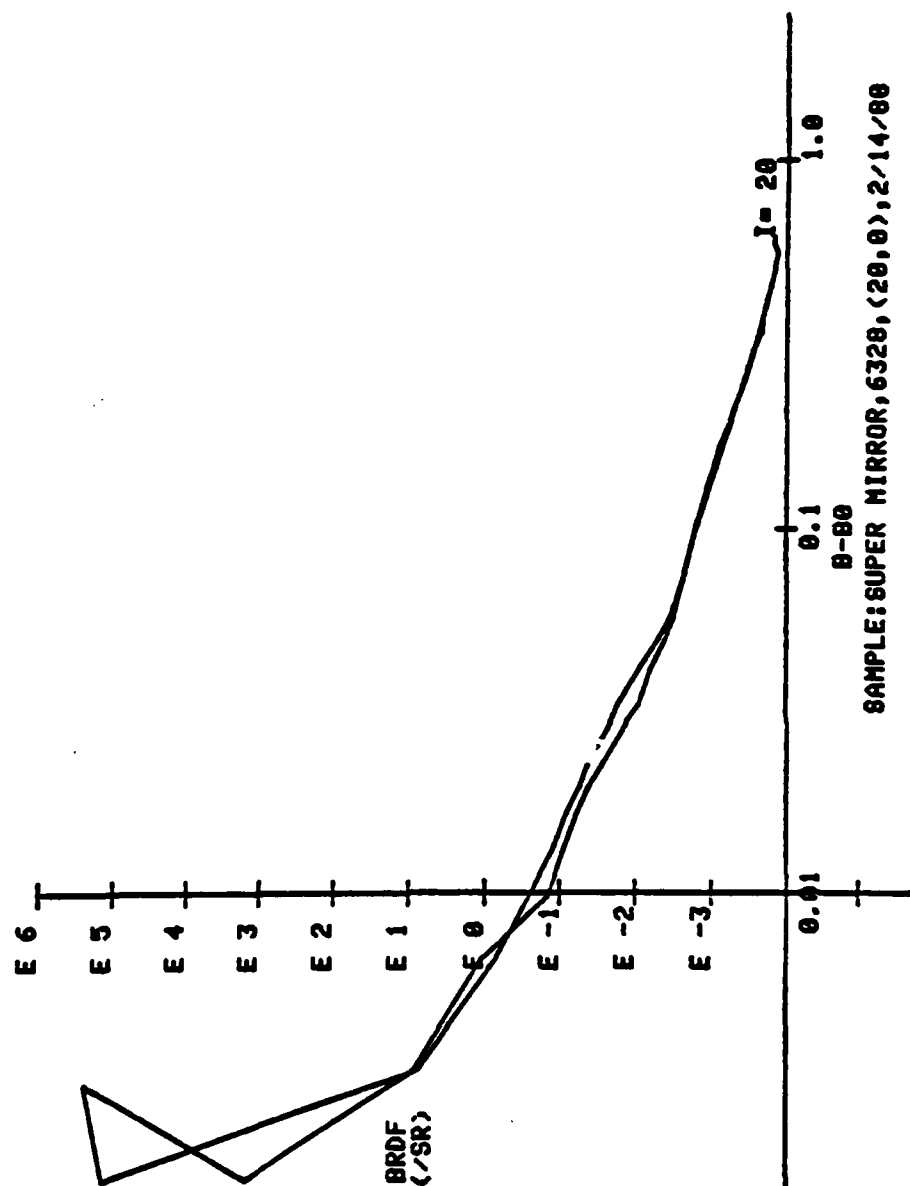
SUPER MIRROR, 6328, (0,0)1/14/80

ANG. FROM SPEC,	BRDF(<SR>
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19.0	2.53880E-004
20.0	2.33480E-004
22.0	1.94871E-004
24.0	1.78003E-004
26.0	1.60821E-004
28.0	1.46168E-004
30.0	1.34121E-004
32.0	1.26312E-004
36.0	1.11667E-004
40.0	1.01084E-004
44.0	8.97061E-005
48.0	8.48648E-005
50.0	8.23194E-005
55.0	7.87522E-005
60.0	7.74350E-005
65.0	8.24521E-005
70.0	7.92417E-005
75.0	8.97558E-005



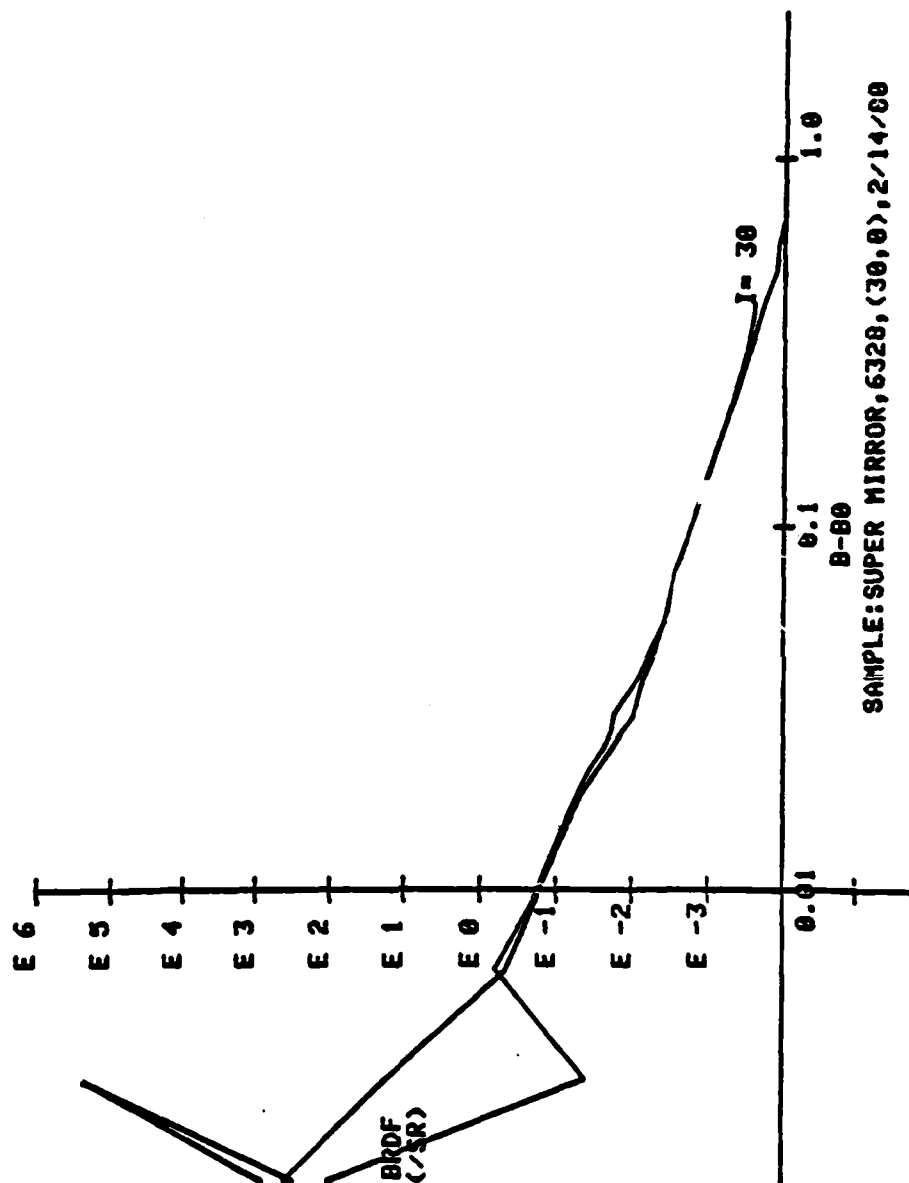
SUPER MIRROR, 6320, (10,0), 2/14/80

ANG. FROM SPEC,	BRDF(</SR>	ANG. FROM SPEC,	BRDF(</SR>
-2.0	2.79610E-002	4.0	2.39417E-003
-1.8	2.37075E-002	4.5	2.05289E-003
-1.6	2.72775E-002	5.0	1.79039E-003
-1.4	3.79712E-002	6.0	1.42315E-003
-1.2	4.06766E-002	7.0	1.16062E-003
-1.0	7.12729E-002	8.0	9.90610E-004
-0.8	1.30740E-001	9.0	8.32618E-004
-0.6	2.37845E-001	10.0	7.05933E-004
-0.4	6.78255E-001	11.0	6.08257E-004
-0.2	6.19128E+000	12.0	5.28937E-004
-0.1	1.29334E+000	14.0	4.12514E-004
0.0	2.28741E+000	16.0	3.38874E-004
0.1	7.15035E+000	18.0	2.92335E-004
0.2	6.32289E+000	20.0	2.38438E-004
0.4	9.24701E-001	25.0	1.78033E-004
0.6	1.40848E-001	30.0	1.46572E-004
0.8	8.36090E-002	35.0	1.29586E-004
1.0	6.21513E-002	40.0	1.12436E-004
1.2	4.32965E-002	45.0	1.03503E-004
1.4	2.87249E-002	50.0	9.80843E-005
1.6	1.91635E-002	55.0	9.46672E-005
1.8	1.43830E-002	60.0	1.01882E-004
2.0	1.12150E-002	65.0	1.19674E-004
2.2	8.58262E-003	70.0	1.33779E-004
2.4	6.73918E-003		
2.6	5.55421E-003		
2.8	4.63215E-003		
3.0	3.97359E-003		
3.5	2.88014E-003		



SUPER MIRROR, 6328, (20,0), 2/14/80

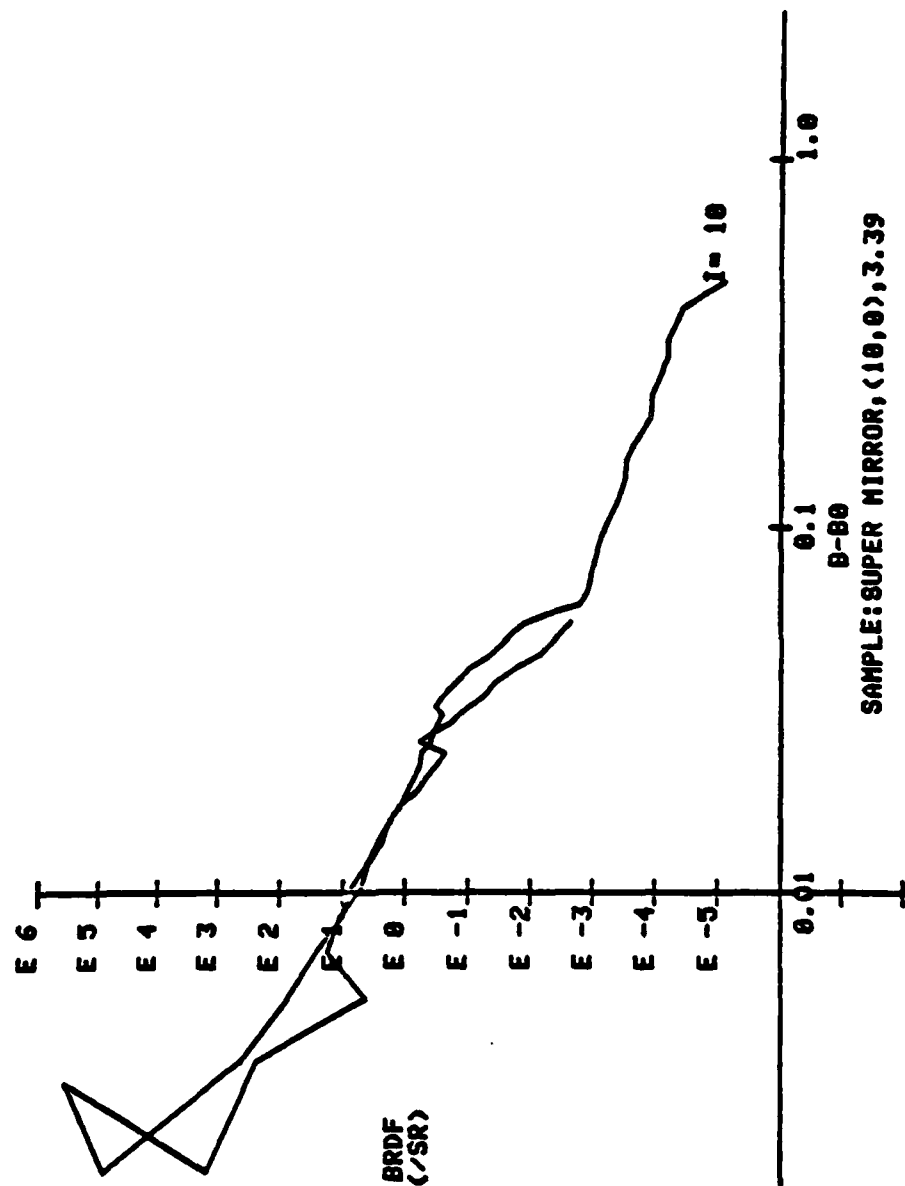
ANG.	FROM SPEC	BRDF(</SR>)	ANG.	FROM SPEC	BRDF(</SR>)
-22.0		2.06619E-004	0.4		1.10656E+000
-20.0		2.19399E-004	0.6		1.37874E-001
-18.0		2.71188E-004	0.8		8.53437E-002
-16.0		3.23434E-004	1.0		5.78095E-002
-14.0		4.02285E-004	1.2		4.02695E-002
-12.0		5.21307E-004	1.4		2.52627E-002
-10.0		7.46981E-004	1.6		1.76662E-002
-8.0		1.06873E-003	1.8		1.26362E-002
-6.0		1.55621E-003	2.0		8.60471E-003
-5.0		1.95072E-003	2.5		6.18834E-003
-4.5		2.25001E-003	3.0		4.07993E-003
-4.0		2.61806E-003	3.5		3.09607E-003
-3.5		3.23843E-003	4.0		2.61353E-003
-3.0		4.79891E-003	4.5		2.28344E-003
-2.5		8.21401E-003	5.0		2.03632E-003
-2.0		1.60126E-002	6.0		1.60821E-003
-1.8		2.02547E-002	8.0		1.05241E-003
-1.6		2.79442E-002	10.0		7.60021E-004
-1.4		3.96133E-002	12.0		5.78295E-004
-1.2		5.27976E-002	15.0		4.12784E-004
-1.0		7.91670E-002	17.0		3.39357E-004
-0.8		1.22745E-001	20.0		2.69558E-004
-0.6		2.48776E-001	25.0		2.19019E-004
-0.4		7.02417E-001	30.0		1.80701E-004
-0.2		7.48187E+000	35.0		1.57504E-004
-0.1		1.31015E+005	40.0		1.44545E-004
0.0		2.39722E+005	45.0		1.34366E-004
0.1		1.49922E+003	50.0		1.47163E-004
0.2		8.50102E+000	55.0		1.49593E-004





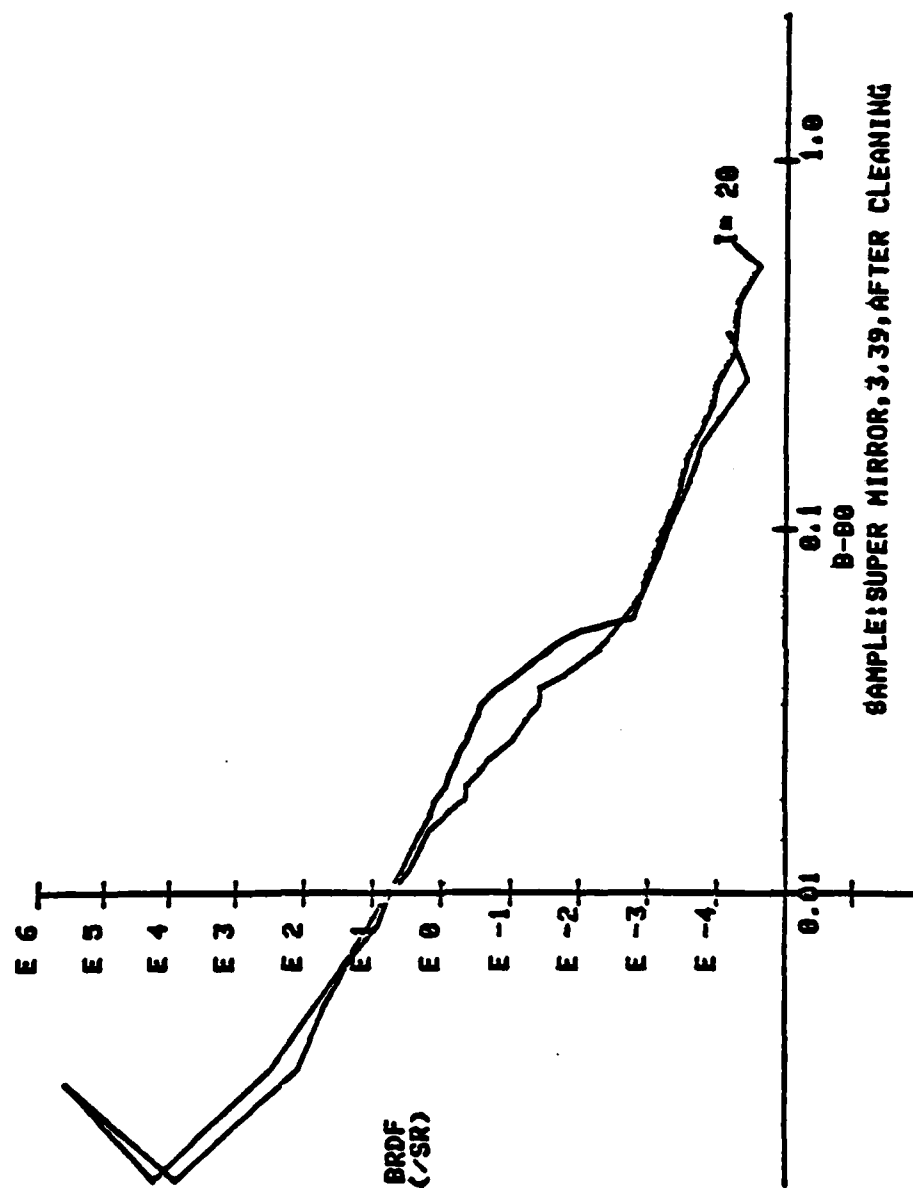
SUPER MIRROR, 6328, (30, 0), 2/14/80

ANG. FROM SPEC	BRDF(<SR)	ANG. FROM SPEC	BRDF(<SR)
-40.0	1.04839E-004	0.6	1.90831E-001
-35.0	1.17892E-004	0.8	1.09272E-001
-30.0	1.29058E-004	1.0	6.95331E-002
-25.0	1.81372E-004	1.2	4.77333E-002
-20.0	2.43752E-004	1.4	3.02403E-002
-15.0	3.87472E-004	1.6	3.02403E-002
-10.0	8.24046E-004	1.8	1.92851E-002
-7.0	1.47214E-003	2.0	1.40809E-002
-5.0	2.49200E-003	2.5	9.68436E-003
-4.5	2.73106E-003	3.0	7.19208E-003
-4.0	3.21643E-003	3.5	5.01663E-003
-3.5	3.80714E-003	4.0	4.02395E-003
-3.0	5.50413E-003	4.5	3.42479E-003
-2.5	8.29339E-003	5.0	3.03804E-003
-2.0	1.72478E-002	8.0	2.67837E-003
-1.8	1.86379E-002	10.0	1.34297E-003
-1.6	2.45416E-002	15.0	9.26605E-004
-1.4	3.74167E-002	20.0	5.11045E-004
-1.2	5.35547E-002	30.0	3.61402E-004
-1.0	7.78040E-002	35.0	2.58117E-004
-0.8	1.23653E-001		2.44302E-004
-0.6	2.10034E-001		
-0.4	6.26101E-001		
-0.2	4.11022E-002		
-0.1	1.64062E+002		
0.0	2.31664E+005		
0.1	5.16414E+002		
0.2	1.71697E+001		
0.4	4.52494E-001		



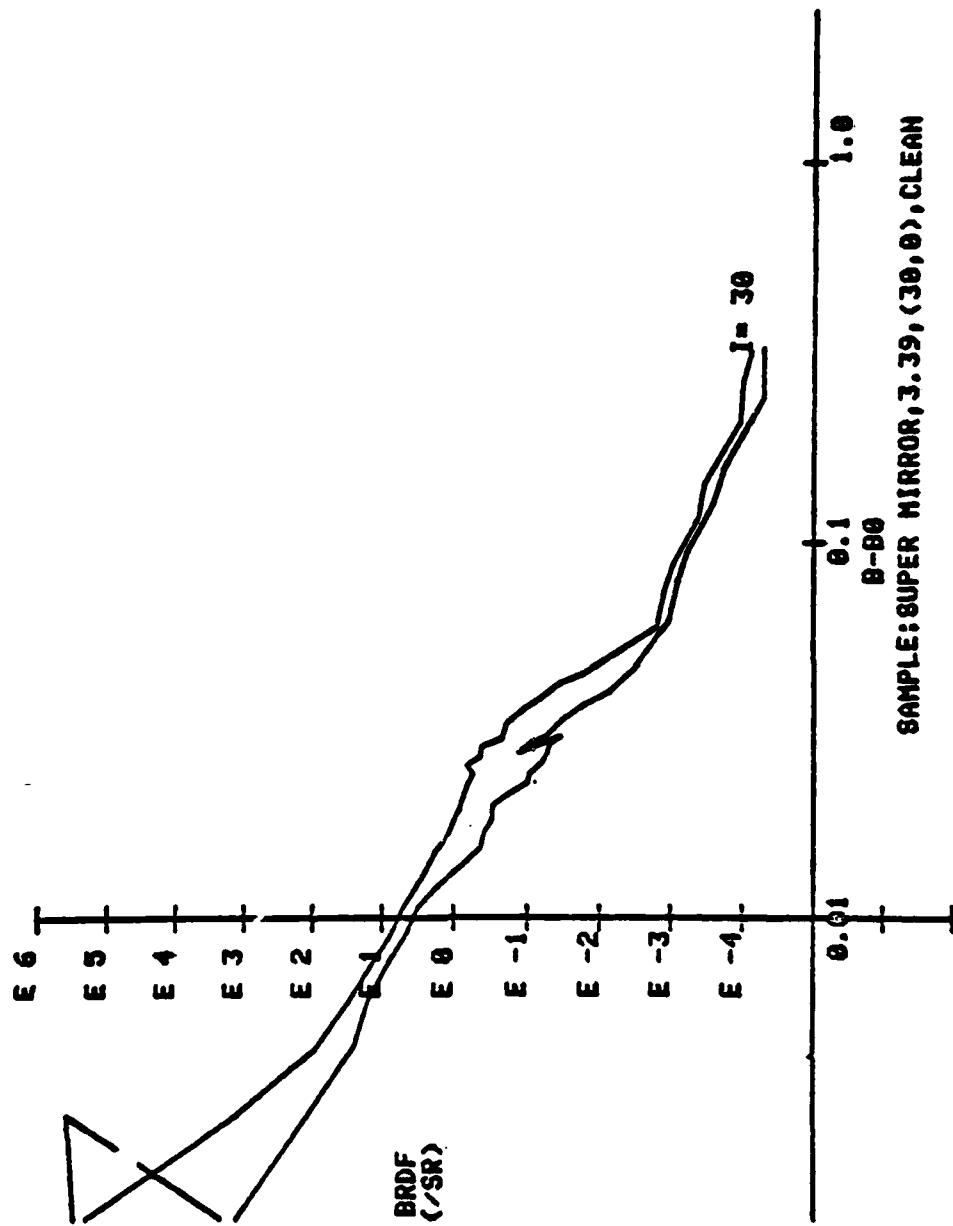
SUPER MIRROR, 3.39, (10,0), AFTER CLEANING

ANG. FROM SPEC	BRDF(/SR)	ANG. FROM SPEC	BRDF(/SR)
-3.2	2.27334E-003	0.4	1.77153E+001
-3.0	3.19631E-003	0.5	1.11905E+001
-2.8	4.61207E-003	0.6	5.07969E+000
-2.6	7.07501E-003	0.7	3.85945E+000
-2.4	1.61261E-002	0.8	2.37010E+000
-2.2	3.55927E-002	0.9	1.87882E+000
-2.0	5.75426E-002	1.0	1.22761E+000
-1.8	1.31909E-001	1.1	9.49001E-001
-1.7	1.84966E-001	1.2	7.43341E-001
-1.6	3.71876E-001	1.3	5.98762E-001
-1.5	5.92812E-001	1.4	5.54161E-001
-1.4	2.35459E-001	1.5	4.01946E-001
-1.3	3.19954E-001	1.6	3.61731E-001
-1.2	4.56353E-001	1.7	3.00554E-001
-1.1	6.40254E-001	1.8	2.61771E-001
-1.0	1.26159E+000	1.9	3.36063E-001
-0.9	1.82395E+000	2.0	2.61964E-001
-0.8	2.75895E+000	2.2	1.59793E-001
-0.7	4.12476E+000	2.4	9.99466E-002
-0.6	7.13078E+000	2.6	4.71988E-002
-0.5	1.00358E+001	2.8	2.87795E-002
-0.4	2.68789E+001	3.0	1.90973E-002
-0.3	7.53129E+001	3.2	1.22197E-002
-0.2	4.31953E+002	3.4	5.33093E-003
-0.1	7.95203E+004	3.6	1.63200E-003
0.0	3.57952E+005	3.8	1.31928E-003
0.1	1.44117E+003	4.0	1.13209E-003
0.2	2.33203E+002	4.5	1.05068E-003
0.3	4.41990E+000	5.0	8.90570E-004
		5.5	7.40751E-004
		6.0	5.90253E-004
		7.0	3.95342E-004
		8.0	3.07916E-004
		9.0	2.90362E-004
		10.0	2.14252E-004
		12.0	1.18441E-004
		14.0	1.13531E-004
		16.0	8.14550E-005
		18.0	6.21877E-005
		20.0	6.34020E-005
		25.0	3.72394E-005
		30.0	7.96421E-006



SUPER MIRROR, 3.39, (20,0) AFTER CLEANING

ANG. FROM SPEC	BRDF(/SR)	ANG. FROM SPEC	BRDF(/SR)
-20.0	6.71103E-005	0.0	3.88481E+005
-15.0	3.67455E-005	0.1	1.68860E+004
-10.0	1.67267E-004	0.2	3.88293E+002
-8.0	2.49490E-004	0.3	6.99414E+001
-6.0	5.03017E-004	0.4	2.46828E+001
-5.0	7.07410E-004	0.5	1.14428E+001
-4.0	1.14877E-003	0.6	6.47597E+000
-3.0	3.77040E-003	0.7	3.92884E+000
-2.0	5.18588E-003	0.8	2.77237E+000
-2.6	8.69517E-003	0.9	1.95919E+000
-2.4	1.63854E-002	1.0	1.42724E+000
-2.2	3.69723E-002	1.1	1.17866E+000
-2.0	3.84894E-002	1.2	8.51217E-001
-1.8	6.01121E-002	1.3	7.37070E-001
-1.6	8.95007E-002	1.4	6.03890E-001
-1.4	2.11654E-001	1.5	5.20904E-001
-1.3	2.79795E-001	1.6	4.18901E-001
-1.2	4.14528E-001	1.7	3.82945E-001
-1.1	4.31799E-001	1.8	3.32748E-001
-1.0	8.30047E-001	1.9	2.82481E-001
-0.9	1.43445E+000	2.0	2.71099E-001
-0.8	2.09313E+000	2.2	1.60123E-001
-0.7	2.97871E+000	2.4	8.71048E-002
-0.6	5.63508E+000	2.6	4.90343E-002
-0.5	8.52774E+000	2.8	2.94503E-002
-0.4	2.05166E+001	3.0	1.80939E-002
-0.3	4.99236E+001	3.2	9.55820E-003
-0.2	1.22320E+002	3.5	1.59665E-003
-0.1	7.53284E+003	4.0	1.28877E-003
		4.5	1.05262E-003
		5.0	8.61650E-004
		6.0	6.31276E-004
		7.0	4.45071E-004
		8.0	3.38577E-004
		10.0	2.53611E-004
		12.0	1.58270E-004
		14.0	1.10386E-004
		16.0	9.80353E-005
		20.0	5.57495E-005
		25.0	5.17632E-005
		30.0	4.74569E-005
		40.0	2.44038E-005
		50.0	5.35139E-005



SUPER MIRROR, 3.39, (30, 0), CLEAN

ANG. FROM SPEC	BRDF(/SR)	ANG. FROM SPEC	BRDF(/SR)
-20.0	4.95685E-005	-0.6	4.57143E+000
-15.0	5.05293E-005	-0.5	7.97424E+000
-10.0	1.68805E-004	-0.4	1.56275E+001
-8.0	2.50043E-004	-0.3	2.47793E+001
-6.0	5.81013E-004	-0.2	1.08665E+002
-5.0	7.94334E-004	-0.1	1.50031E+003
-4.0	1.01819E-003	0.0	3.69938E+005
-3.0	3.30037E-003	0.1	2.87891E+005
-2.8	5.06230E-003	0.2	1.16203E+003
-2.6	7.62776E-003	0.3	8.78472E+001
-2.4	1.69355E-002	0.4	2.81886E+001
-2.2	3.23468E-002	0.5	1.37479E+001
-2.0	5.63035E-002	0.6	7.60401E+000
-1.9	9.06018E-002	0.7	5.36407E+000
-1.8	1.28039E-001	0.8	3.28997E+000
-2.0	3.48251E-002	0.9	2.38900E+000
-1.9	4.81365E-002	1.0	1.79363E+000
-1.8	5.31658E-002	1.1	1.24831E+000
-1.7	6.15306E-002	1.2	1.01511E+000
-1.6	8.98861E-002	1.3	8.43105E-001
-1.5	9.99675E-002	1.4	7.58230E-001
-1.4	1.86784E-001	1.5	6.68024E-001
-1.3	2.95467E-001	1.6	5.48481E-001
-1.2	3.00763E-001	1.7	6.69460E-001
-1.1	3.98058E-001	1.8	4.32432E-001
-1.0	4.33599E-001	1.9	4.15654E-001
-0.9	8.11064E-001	2.0	2.21003E-001
-0.8	1.66061E+000	2.2	1.90340E-001
-0.7	3.25731E+000	2.4	1.11277E-001
		2.6	6.26595E-002
		2.8	3.57826E-002
		3.0	1.61495E-002
		4.0	1.50125E-003
		5.0	1.20656E-003
		6.0	8.74776E-004
		8.0	3.87110E-004
		10.0	3.26533E-004
		15.0	1.03536E-004
		20.0	9.49138E-005
		25.0	7.44566E-005

Army Materials and Mechanics Research Center  
Watertown, Massachusetts 02172  
SCATTERING MEASUREMENTS OF RAYTRAN ZINC  
SELENIDE IN TRANSMISSION AT WAVELENGTHS  
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F. O. Bartell, A. G. DeBell, E. L. Dereniak,  
J. Hubbs, T. Stuhlinger, and W. L. Wolfe  
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Tucson, Arizona 85721  
Technical Report AMMRC TR 81-38, August 1981,  
157 pp.-illus.-tables, Contract DAAG46-79-M-  
0871

D/A Project: 8X363304D215; AMCMS Code:6333.04.21500.05  
Final Report, August 1979-April 1981

The transmission scattering of three samples of different thicknesses of zinc selenide were measured. The samples were 1/4", 3/4", and 1" thick. Fifty-four plots of the BTDF were made utilizing the scattering data obtained at .6328, 3.391, and 10.6  $\mu$ m.

AD Unclassified  
Unlimited Distribution  
  
Key Words  
Infrared Optical Materials  
Infrared Windows  
Forward Scattering  
Light Scattering  
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